THE UNIVERSITY OF ALBERTA

ANALYSIS OF QUOTA POLICY
PROBLEMS, OBJECTIVES, AND ALTERNATIVES
IN THE WESTERN GRAIN INDUSTRY

by

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The undersigned certify that they have read and recommend to the Faculty of Graduate Studies for acceptance a thesis entitled "Analysis of Quota Policy Problems, Objectives, and Alternatives in the Western Grain Industry," submitted by George Gilbert Pearson in partial fulfilment of the requirements for the degree of Master of Science.

ABSTRACT

An analysis of Western grain delivery quota policy problems, objectives, and alternatives is conducted employing economic theory, literature sources, regression analysis, linear programming, deductive reasoning, and subjective probability analysis.

Study of the relationship between quota policy and grain production, marketing, and income problems reveals that traditional quota policy may contribute significantly to a lower level of efficiency. The tying of quotas to land under traditional quota policy has induced overutilization of land in production processes. Quota equalization has dispersed demand, delivery opportunities, market channels, and income across the prairies regardless of comparative advantage, soil-climatic conditions, or producer preferences. Equalization of quotas and boxcar allocation has contributed to low handling/capacity ratios at country elevators.

Analysis of potential quota policy objectives suggests conflicts among orderly marketing, production and marketing efficiency, equality, and equity (in the sense of Pareto optimum allocation). Reasonable economic objectives for demand allocation are orderly marketing and production and marketing efficiency; these contrast with an apparent industry consensus on orderly marketing, equal demand allocation, and supply control.

Three alternative demand allocation programs are specified: 1) the open market; 2) assignable acreage quotas; and 3) negotiable marketing certificates. Analytical results suggest that for a set of eight policy objectives and a subset of three economic objectives, the open market has the highest probability of attainment. For the subset of industry consensus objectives, the assignable acreage quotas have the highest probability of achievement.

Analytical results necessitate the conclusion that the open market is optional, among the three alternatives examined, for allocating demand among Western grain producers--implying some change in grain industry structure.

A negotiable marketing certificate system is suboptimal, but appropriate for simultaneous attainment of supply control and efficiency, especially in insulated commodity markets where demand elasticity is low and price maximization is an objective.

The assignable acreage quota system is also suboptimal, but correct for the objectives at which it is aimed; however, the objectives appear to be inappropriate for the long run competitive interests of the Western grain industry, the prairie region, and the national economy. Annual market clearing (except for planned carry-over) would offset many of system's potentially harmful impacts.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Statement of the Problem

For thirty years the Canadian Wheat Board has operated a quota system for regulating the delivery of prairie grain into commercial channels. While the mechanics of the system have changed over time, its specific purpose--to ensure the equitable[1] distribution of delivery opportunities and elevator space among producers--has not [Riddel, 1961, p. 5]. The quota system was not intended to influence levels or patterns of grain production. 'The quota system constitutes a producer sales quota; it is not a production quota system; . . . and delivery opportunities are not imposed [to place] restrictions on producers.' [CDA, CFE 4:3, 1969, p. 22].

The Federal Task Force on Agriculture concluded from its review of the quota system that, if used at all, it should primarily facilitate the movement of grades of grain required by the market within the crop year [MacFarlane, 1969, p. 132]. The federal government's LIFT (Lower Inventory for Tomorrow) Program

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[1]Equitable (equity) in relation to quota policy typically means equal in proportion to land. In the present study equitable means that quality of fairness and justness associated with a Pareto optimum. Efficiency implies equitable, but not necessarily equal, demand allocation; conversely equal allocation is not necessarily efficient nor equitable.

utilized the quota system to help reduce wheat production substantially in 1970. Evidence suggests a schism between the actual impact and the stated intent of past quota policy on organization and performance of grain production and marketing activities, and on income distribution among farmers.

The problem involves the existence of a policy instrument--the grain delivery quota system--which appears to have lacked in the past full consideration of its potential objectives or precise clarification of its economic impact. Two federal government committees[1] and at least one farm organization [McLeod, 1969] have recently examined quota policy in an attempt to devise a policy with means-ends consistency. It is not clear whether or not this has yet been accomplished.

The Boden Committee on Quota Policy acknowledges that its report should not be taken as the last word on quota policy:

> The proposed system outlined in this report is not the ultimate as future conditions and studies may require changes or indicate further improvements. . . . In depth studies should be made of the basic concepts incorporated in the present quota system, the system proposed by the Committee and other proposals that have been suggested. Periodic reviews of the quota system, perhaps every other year, should be made. This should take account of experience since the previous review, changes in factors such as technology and market demand, and the findings of studies completed [Boden, 1970, p. 17].

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[1]The two committees are the Committee on Quota Policy, February, 1970, chaired by E.A. Boden and the Grain Production Policy Group, July, 1970, chaired by G.A. Hiscocks; both were appointed by the Honorable Otto E. Lang, Minister-In-Charge of the Canadian Wheat Board.

Evidence of the need for continued analysis, especially of particular aspects of quota policy, is contained in the document, Prairie Grains Policy: Proposals:

> Considerable interest has been expressed by farm organizations in attempting to find the method whereby productivity can be included as a factor in the quota system. . . . This issue is a complex one and will require more study before proposals can be put forward [Lang, 1970].

The need for further study of quota policy and productivity is expressed in a letter from A. D. McLeod of the Saskatchewan Wheat Pool:

> One of the most intricate and perplexing questions in the whole quota question is the problem of recognizing productivity. . . . As far as I am aware no one has yet suggested a quota proposal which would adequately take productivity into account [McLeod, 1970].

In an interview, CWB officials recognized a need for continued investigation [CWB, 1970]. Analysis of quota policy utilizing specific economic and empirical tools appears, therefore, to be sufficiently justified.

Study Objectives and Procedures for Analysis

Building upon work that has already been done, this analysis has the following objectives:

1. To delineate a package of economic theory as a conceptual framework for analysis of quota policy.

2. To review quota policy history in order to explain its evolution.

3. To study the relationships between quota policy and problems in the production and marketing of grain.

4. To analyze the income effects of quota policy and its potential objectives.

5. To postulate several alternative programs for allocating demand among producers.

6. To hypothesize the relative potential of each program for attaining various objectives.

7. To test and draw conclusions about the impact of program alternatives on the production, marketing and profit maximizing activities of a typical prairie grain farm.

The analytical procedures focus on CWB quota policy as a problem set. Regression analysis, deductive argument, theory, and literature sources are utilized to analyze the relationships between quota policy and production, marketing, and income problems. Objectives for quota policy in light of grain industry wants and needs are appraised. Of the many possible alternative programs for allocating demand among producers, three are selected for analysis of impact on the profit maximizing performance of a typical prairie grain farm. Linear programming is the analytical tool used. In the context of policy formulation, conclusions are drawn from the analysis about the relative probability of the three programs' achieving various objectives. Public policy implications arising from the present study are discussed. Finally, limitations of the analytical procedures and results obtained therefrom, are outlined.

CHAPTER II

ECONOMIC THEORY AND QUOTA POLICY

The purpose of this chapter is to outline a package of economic theory as a conceptual framework for analysis of quota policy. Neoclassical microeconomics is the source of demand, competition and supply response theory. Six cases of modified perfect competition are postulated to explain the theoretical distinctions between orderly marketing, supply control, and supply management. Demand-supply equilibrium and firm profit maximization under perfect competition are discussed. It is assumed that the economic theory presented here sufficiently describes and simplifies the complex phenomena prevailing in the prairie grain industry to permit reliable predictions about quota policy impacts.

Demand and Competition

Demand Functions

In final product markets, repeated testing has consistently confirmed that for a broad class of demand phenomena the quantity of a commodity Q which any consumer i will purchase depends primarily on the price of the commodity, the prices of commodities which are substitutes or complements in consumption, income, wealth, and tastes and preferences. The final demand function for an

individual consumer i can be expressed as follows [Boyne, 1964, p. 85]:

$$Q_{di} = f(P_q, X_1, X_2, X_3 \ldots X_i) \qquad (2\text{-}1)$$

where: Q_{di} = the quantity of a commodity Q demanded by an individual consumer i per unit of time.

f = the functional relationship between dependent and independent variables given constant tastes and preferences.

P_q = the price of commodity Q.

X_1 = the prices of commodities which are substitutes or complements in consumption.

X_2 = the level of individual consumer income.

X_3 = the level of individual accumulated wealth.

X_i = other identifiable variables such as customs, tradition and institutional factors which may affect the quantity of Q demanded.

Equilibrium analysis in the Q commodity market necessitates that the quantity of Q demanded be a function of its own price with all other variables constant. The demand function representing the quantity of Q demanded by consumer i at various price levels (P_q), ceteris paribus, is expressed as:

$$Q_{di} = f(P_q \mid X_1, X_2, X_3 \ldots X_i)$$

or

$$Q_{di} = f(P_q) \qquad (2\text{-}2)$$

The aggregate demand for commodity Q--the demand of all consumers participating in the commodity market at a particular price level--is the summation of quantities demanded by all consumers. The aggregate demand

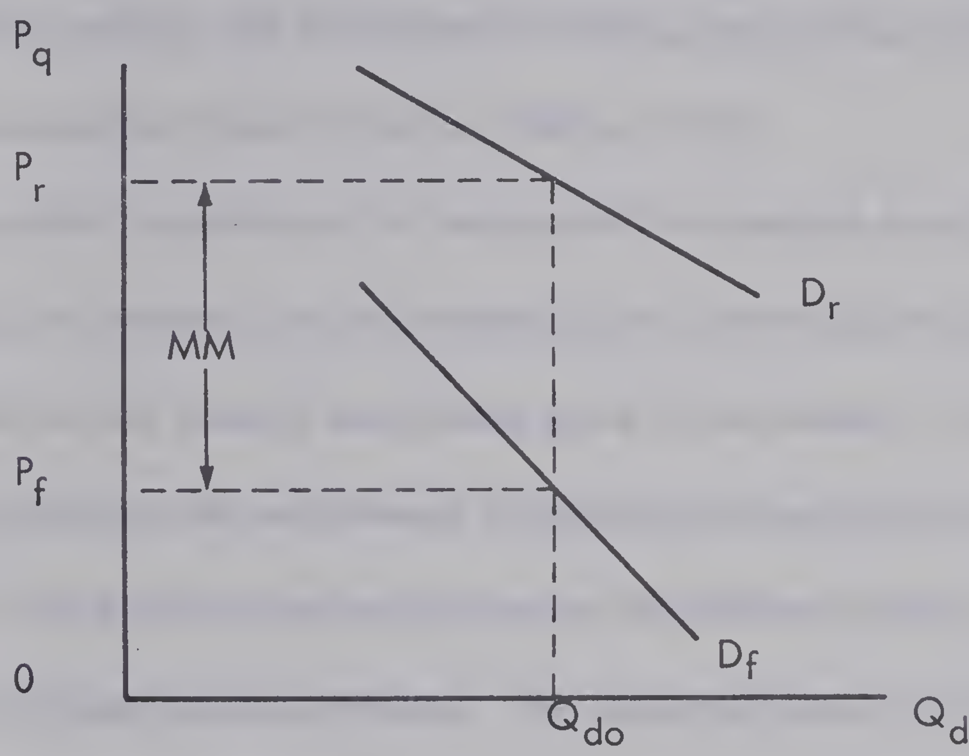
function represents total quantity demanded (Q_d) at various price levels (P_q), *ceteris paribus*, for n consumers. Individual and aggregate demand curves are typically negatively sloped, meaning quantity demanded varies inversely with price, *ceteris paribus*.

For grain, aggregate consumer demand represents final or retail demand (D_r) for products processed from grain: bread, ale, cooking oil, etc. The demand for grain at the farm level (D_f) as a raw material input is derived from final demand. The marketing margin (MM) is the spread between the price the consumer pays (P_r) and the price the producer receives (P_f) at any aggregate output level (Q_{do}). The marketing margin includes the cost of activities such as handling, storage, transportation, CWB operation, processing, wholesaling, and retailing. Specifically, $P_f = P_r - MM$.

Marketing costs may be 'specific'--fixed dollar value markup--or '*ad valorum*'--fixed percentage markup. If marketing costs are all *ad valorum*, the price elasticity of demand at retail and farm are the same at each output level; if marketing costs are all specific, demand elasticity at farm level is less than at retail. In practice marketing costs for grain consist of a sequence of specific and *ad valorum* elements. The elasticity of derived demand for prairie wheat exported to the United Kingdom is estimated to be .32 when retail demand elasticity is 1.0 [Usher, 1970, p. 441]. The typical retail-farm demand relationship for grain, showing the derived demand curve to be less elastic, is depicted in Figure 1.

Figure 1

THE RELATIONSHIP BETWEEN FINAL AND DERIVED DEMAND



Source: J. N. Ferris, "Equilibrium and Overall Adjustment," in Agricultural Market Analysis: Development, Performance, Process, V. L. Sorenson, ed. (East Lansing: Bureau of Business and Economic Research, Michigan State University, 1964), p. 234.

According to J. N. Ferris, A. Marshall's principles governing derived demand elasticity [Marshall, 1920, p. 385] are exemplified in the highly inelastic demand for wheat for domestic food. In general, farm level demand is less elastic: 1) the more essential the farm product is to the retail product or the greater the lack of viable substitutes for the farm product (wheat is an essential ingredient in bread); 2) the less elastic is the final demand curve (the retail

demand for bread is relatively inelastic); 3) the smaller the proportion the farm price is to the retail price (wheat prices represent a small proportion of the retail price of bread); 4) the more inelastic are the supply curves for marketing services and substitute farm products (the facilities for handling and milling wheat and for baking bread are relatively fixed) [Ferris, 1964, p. 233].

Under perfect competition the industry derived demand curve for a particular prairie grain is inelastic, but the demand curve confronting an individual farm is perfectly elastic at the level of equilibrium price in the industry. In an unconstrained sales situation derived demand is allocated among producers by the price mechanism. In a constrained sales situation the delivery quota system allocates derived demand among producers. The economic aspects of the latter are the focus of the present study.

Competition

In theory, various degrees of competition are normal. At one extreme is monopoly--a single seller--and monopsony--a single buyer--enjoying the absence of competition with complete control over product supply, price, and entry into the industry. At the other extreme is perfect competition, rigorously defined as a market structure characterized by the following conditions: 1) there are a large number of buyers and sellers, none of whom thinks he can influence the price of a commodity through his own individual action; 2) all sales involve perfectly homogeneous commodities; 3) all buyers and sellers have perfect knowledge of the situation confronting them and of their alternatives; 4) all

buyers and sellers behave rationally to maximize their own self-interest (however defined) on the basis of that knowledge; and 5) freedom of entry into the market and perfect mobility of inputs exist [Liebhafsky, 1968, p. 26]. The degree of competition becomes less perfect as the various assumptions are relaxed. Models of intermediate competition include oligopoly, a few sellers; oligopsony, a few buyers; and duopoly, two sellers.

Most market structures in the real world lie somewhere between perfect competition and monopoly. In the past, the product market for grain producers was a close approximation of perfect competition. However, this is less true today: two hundred thousand farmers face an oligopsony in the quota regulated, non Canadian Wheat Board market; behave via the Canadian Wheat Board as a monopoly for domestic sales and an oligopoly for export sales; and sell in an imperfect version of perfect competition in the non-quota regulated market. In factor markets for crop inputs, farm equipment, and credit, farmers face a number of oligopolies.

Imperfect competition in the form of government sanctioned monopolies and corporate oligopolies is characteristic of modern industrial organization. Many authors [Fisher, 1967; Galbraith, 1967; Packard, 1957] describe the immense capacity developed by corporate enterprise to manipulate its business environment, especially demand, by competition control and advertising. It is apparent that Canadian agriculture is also moving in this direction with the assistance of provincial and federal legislation permitting the establishment of quasi-monopoly agricultural

product marketing boards. There is evidence of an increasing shift in Canadian agriculture, including the grain industry, from supply to demand orientation; towards a definition of marketing as a process of analyzing, organizing, planning, and controlling resources, policies, and activities with a view to satisfying the needs and wants of chosen customer groups at a profit [Kotler, 1967, p. 12].

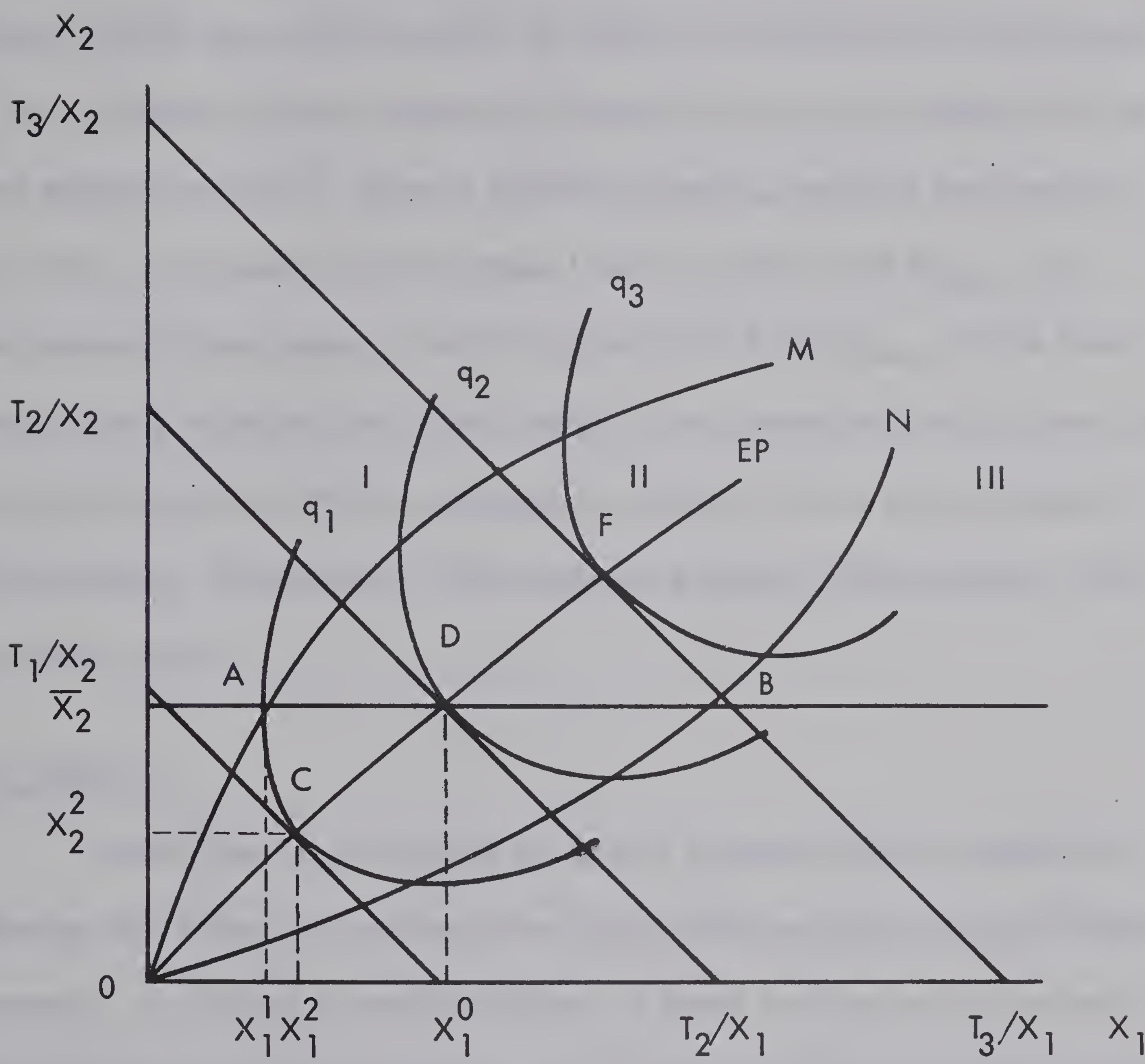
Supply Response Theory

Production Theory

Two basic assumptions underlying production theory are good management and use of the best available technology. A production contour surface for the case of two factors (X_1 and X_2) and one product (Q) is depicted in Figure 2. Isoquants (q_n) represent various technical combinations of X_1 and X_2 required to produce various levels of Q. The marginal technical rate of substitution (MTRS) is the rate at which factors are substitutable for each other in production space; it is equal to the ratio of their marginal physical products. The marginal physical product (MP) of a factor, a partial derivative, expresses the contribution to output of one additional unit of the factor. Ridge lines (M, N), loci of MP's = 0, enclose stage II of the production space where all factor combinations are rational. Stage I, lying left of M, and stage III, lying right of N, are irrational; the same level of output could be produced by using less of both factors.

Figure 2

A TYPICAL ISOQUANT-ISOCOST CONTOUR SURFACE



Source: R. H. Leftwich, The Price System and Resource Allocation (3rd ed.; New York: Holt, Rinehart and Winston, 1966), p. 125.

If X_2 (land) is held constant at a level $\overline{X}_2$, a plane cuts through the contour surface along the line $\overline{X}_2AB$ parallel to the X_1 (capital) axis yielding a production function $Q = f(X_1, \overline{X}_2)$. Q represents various levels of output (wheat) possible when various amounts of capital are combined with a fixed amount of land. Average (AP) and marginal (MP) product curves can be derived from the total product function Q. When Q exhibits increasing, constant, and decreasing returns, the boundary between stages I and II is where $MP = AP_{max}$ and the boundary between stages II and III is where MP = 0 and Q_{max}. While factor combination is technically efficient in stage II, the appropriate level of production to maximize economic efficiency depends on economic choice criteria [Baumol, 1965; Ferguson, 1966; Heady, 1952; Henderson & Quandt, 1958; Leftwich, 1966; Liebhafsky, 1968].

Cost Theory

Isocost lines (T_n) illustrated in Figure 2 represent different combinations of factors that a farm can purchase given factor prices and various levels of budget constraint. To achieve economic efficiency of factor combination the firm must attain either the highest isoquant for a given cost outlay or the lowest isocost line for a given output level. Assume output (wheat) is constrained at q_2 and X_2 is fixed at $\overline{X}_2$, then least-cost (efficient) resource combination occurs where the firm utilizes X_1^o units of X_1 (capital). Any other combination of X_1 with $\overline{X}_2$ results in a greater total cost per unit of output. Alternatively, point D is the maximum output level possible for a budget constraint T_2.

Economic efficiency occurs when the marginal product/factor price ratios are equal for all factors, or when the isoquant-isocost slopes are equal. For the cost curves derived from the production function and the total cost function, X_2 constant, least cost factor combination is attained where marginal cost approximately equals the average total cost minimum. A line through CDE represents the firm's expansion path or locus of efficient production points when both factors are variable. Departure from this path in response to either internal or external influences creates inefficiency in resource utilization and increases average production cost because at least one resource will be over-utilized with respect to its marginal product and price. In the long run, grain farmers generally strive to combine resources with land to the point at which long run average total cost is minimum, a definition of an economic unit.

Supply Functions

For a broad range of supply phenomena, repeated testing has consistently confirmed that the quantity of a commodity a firm supplies depends primarily upon the price of the commodity, the prices of factors of production, and the state of technology. The relationship among these variables of the supply function for an individual firm can be expressed as follows [Boyne, 1964, p. 84]:

$$Q_{si} = f(P_q, X_1, X_2 \quad . \quad . \quad . \qquad X_i) \tag{2-3}$$

where Q_{si} = the quantity of commodity Q supplied by an individual firm i per unit of time.

f = the functional relationship between dependent and independent variables given a constant state of technology.

P_q = the price of commodity Q.

X_1 = the prices of other commodities which the firm can produce.

X_2 = the prices or index of prices of factors of production.

X_i = other identifiable variables such as weather, tradition and institutional factors which may affect the quantity of Q supplied.

When all independent variables except the price of commodity Q are held constant, the supply function may be rewritten as:

$$Q_{si} = f(P_q | X_1, X_2 \ldots X_i)$$

$$\text{or} \quad Q_{si} = f(P_q) \tag{2-4}$$

The short run supply curve (in stage II of the firm's production function) is equivalent to that portion of its marginal cost curve above the minimum point on its average variable cost curve and equal to zero below. The aggregate supply of commodity Q, or the quantity supplied by all producers participating in the commodity market at a particular price level, is the horizontal summation of individual supply curves. Individual and aggregate supply curves are typically positively sloped, meaning quantity supplied varies directly with price, _ceteris paribus_.

When production occurs during only a small proportion of the marketing period and inventories are assumed to be constant, total supply is fixed for a particular marketing period. In this instance individual aggregate supply curves are vertical; thus total quantity supplied is unaffected by price changes.

However, the proportion of total supply marketed each month during the crop year is a function of seasonal price determined by the interaction of supply and demand. This phenomenon occurs for grain production and marketing which are unimpeded by controls such as delivery quotas [Leftwich, 1966, p. 157].

Elasticity of supply measures the proportional change in output associated with a unit change in product price; it reflects the degree of flexibility firms have for shifting production facilities among alternate products. In agriculture aggregate supply elasticity is a function of the planning horizon and the direction of price change across production periods. Elasticity of supply for United States agriculture has been measured by Tweeten and Quance [1969, p. 351]

Table 1

SUPPLY ELASTICITY FOR UNITED STATES AGRICULTURE

Time Horizon	Direction of Price Movement	
	Price Down	Price Up
Short Run	.10	.15
Long Run	.80	1.50

Source: L. G. Tweeten and C. L. Quance, "Positivistic Measures of Aggregate Supply Elasticities," American Journal of Agricultural Economics, 1969, pp. 342-52.

Table 1 indicates that in the short run, supply response is highly inelastic for price movements in either direction; in the long run it is inelastic for downward price movements and elastic for upward price movements. For prairie grain it can be anticipated that supply elasticity is modified by pooled pricing and delivery quota policy.

Modifications of Perfect Competition

Several assumptions of perfect competition are violated when the model is applied to the prairie grain industry at the farm level. Each commodity lacks universal homogeneity because a grading system permits product differentiation by grade and also by protein level under 1971 revisions of the Canada Grain Act. All buyers and sellers do not possess perfect market information. Canadian Wheat Board legislation, limited elevator-transportation capacity, and a seasonally fixed supply impose constraints on mobility of factors and products. Perfect competition does not exist in factor markets. These deviations all influence aggregate price-quantity interaction within and across crop years.

It is possible to conceive of several formal modifications of perfect competition in order to attain specific price-quantity relationships. Six modified versions of perfect competition are postulated to help explain some of the theoretical distinctions between 'the open market,' 'orderly marketing,' 'supply control,' 'supply management,' 'open market pricing,' and 'pooled pricing' in the context of the prairie grain industry. Figures 3 through 8 illustrate relation-

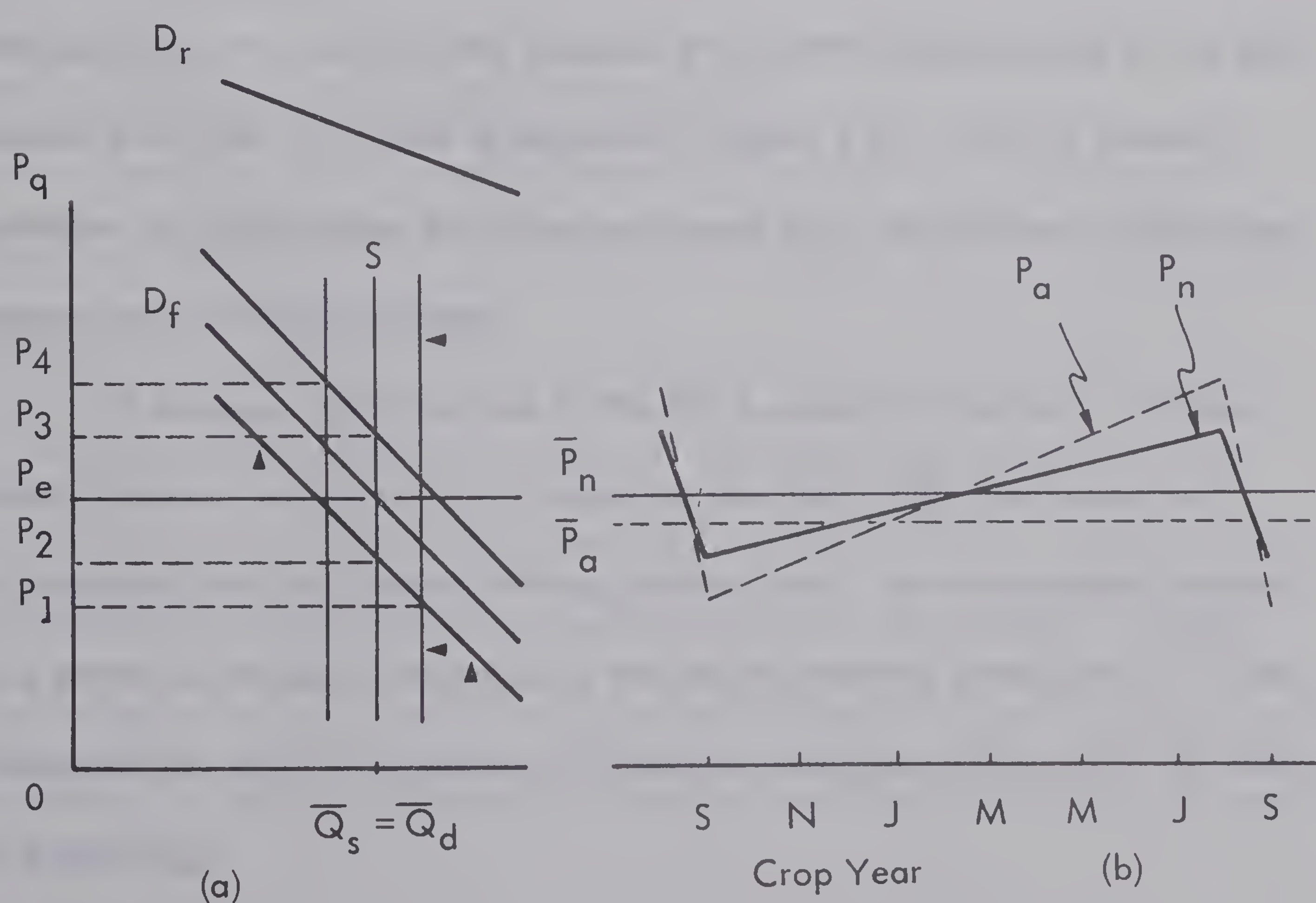
ships between aggregate demand-supply-price interaction and commodity seasonal price trends among various versions of farm level market modification. Year-end inventory levels are assumed to be constant in all cases.

Case 1: Open Market

In the present study 'open market' is defined as a market situation in which the conditions of perfect competition are largely fulfilled. Case 1 describes the market situation prevailing for prairie grain prior to the implementation of the delivery quota system and the current situation in the non-quota market and the Ontario grain corn market [Pearson, 1968, p. 2].

Figure 3

PRICE-QUANTITY RELATIONSHIPS: THE OPEN MARKET



In Figure 3, (a) the aggregate supply curve (S) represents a fixed annual supply of, for example, wheat or an average monthly supply of $Q_s/12 = \overline{Q}_s$. Aggregate farm demand (D_f) differs at each output level by the magnitude of the marketing margin (MM). Demand is assumed to be distributed evenly throughout the marketing period with total quantity demand each month ($\overline{Q}_d$) equal to $\overline{Q}_s$. The marketing margin is greatest (derived demand lowest) following harvest and diminishes (derived demand curve shifts upward) seasonally as the remaining total commercial storage and financing costs to the next harvest decline. The derived demand curve is normally at a low point in the fall because buyers assume sellers will dispose of total supply after harvest, necessitating commercial storage of the grain until it is resold to processors and importers. If producers sell an equal amount of grain each month, the derived demand curve shifts upward along the fixed supply curve, and a normal seasonal price pattern (represented by the solid seasonal price line P_n) occurs as depicted in Figure 3 (b). Price is lowest in September (P_2) and highest the following August (P_3), the difference reflecting average annual carrying charges.

If producers offer for sale in the fall a quantity in excess of average monthly demand, the supply curve begins to the right of $\overline{Q}_s$ and moves left simultaneously with an upward shifting demand curve. An accentuated seasonal price pattern develops (represented by the dashed seasonal price line P_a); it has a depressed low point in September (P_1) and an accentuated high point the following August (P_4).

Producers selling in the fall receive a lower and those selling in the spring a higher price than would occur if supply flowed evenly onto the market in relation to demand. The weighted average seasonal price ($\overline{P}_a$) is lower under an accentuated seasonal price pattern than under a normal seasonal price pattern ($\overline{P}_n$). If buyers' reselling prices are the same in both situations, they earn profits in excess of normal seasonal carrying charges under an accentuated price pattern. It is to the middleman's advantage to encourage excessive fall marketings and to the producer's advantage to space marketings evenly throughout the crop year. Although the price mechanism ought to encourage an even flow of product, a lack of adequate farm storage, a need for cash, and imperfect information on the selling side may contribute to fall marketings in excess of demand and a lower average seasonal price.

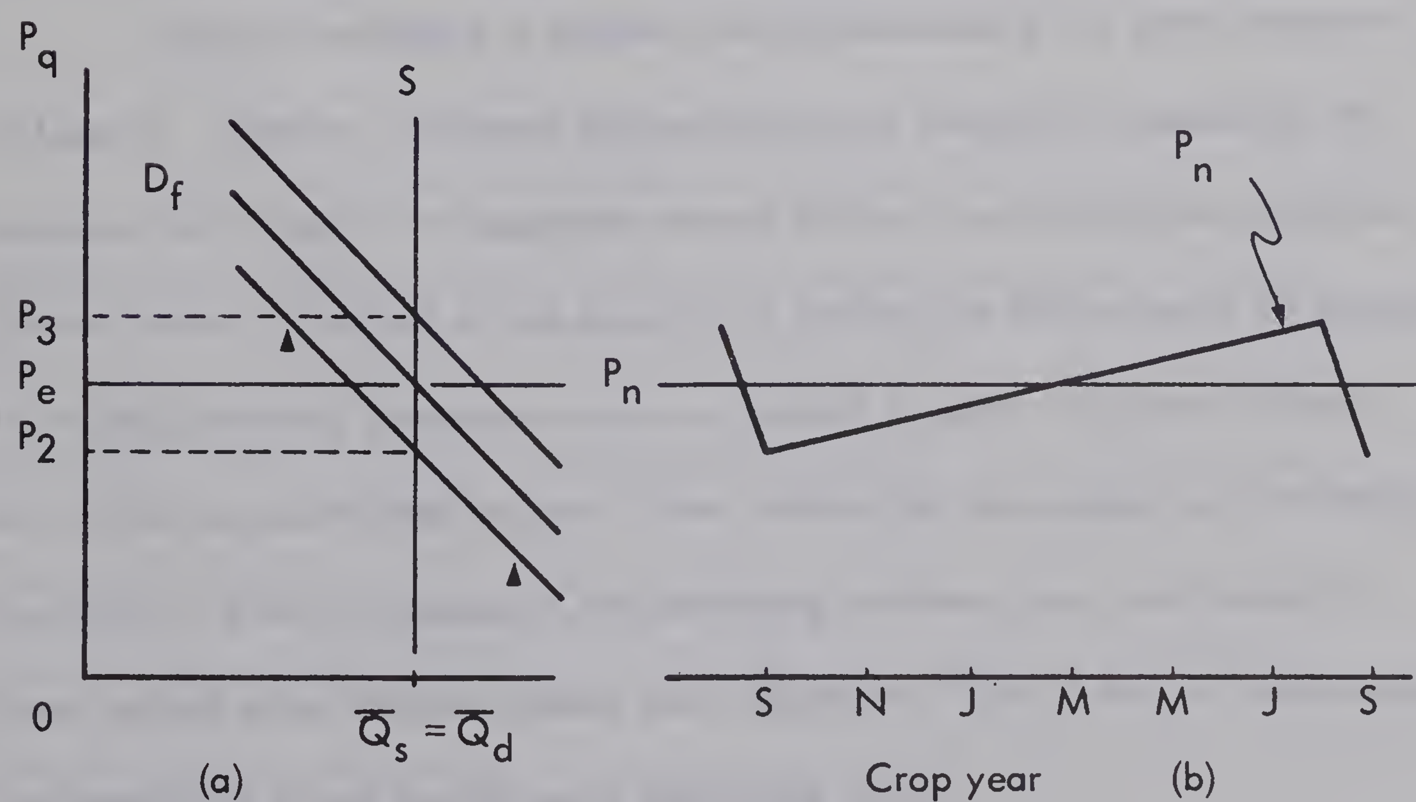
Case 2: Orderly Marketing; Open Market Pricing

Orderly marketing is defined in the present study as the process of matching the seasonal flow of grain with demand specifications in four dimensions--quantity, quality, position, and timing [Boden, 1970, p. 4; Oldenstadt, 1964, p. 198]. Open market pricing is defined as a seasonal commodity price pattern reflecting a normal allowance for storage and financing charges. Orderly marketing is assumed to be implemented by seller group action, for example, through a central agency such as the CWB endowed with authority to call grain into marketing channels in relation to demand specifications via a delivery quota mechanism.

The underlying supposition is that a central agency has better market information on which to base commodity flow decisions than many thousands of producers acting independently. No aggregate annual delivery restrictions are permitted to raise average seasonal price above that which would prevail under normal open market clearing; only commodity flow limitations within the crop year are permitted. Case 2 corresponds closely to current marketing practice for prairie rye, flax, and rapeseed.

Figure 4

PRICE-QUANTITY RELATIONSHIPS:
ORDERLY MARKETING; OPEN MARKET PRICING



The economic characteristics of Case 2 are portrayed in Figure 4. Monthly supply is regulated to conform more closely with a monthly average, and any deviations are planned in response to deviations in demand. The theoretical impact is the avoidance of an accentuated seasonal price pattern--supply-demand imbalance and depressed prices after harvest--and the attainment of an average annual seasonal price more in line with that expected under open market conditions and normal seasonal carrying charges. The seasonal price would tend to be the maximum possible under market clearing activity; excessive income transfers to middlemen via an accentuated price pattern would tend to be minimized.

Case 3: Orderly Marketing; Pooled Pricing

Orderly marketing is defined and implemented in the same manner as in Case 2. Likewise, the quota system serves as a vehicle for regulating the seasonal flow of grain; no aggregate annual delivery restrictions are permitted. Pooled pricing is defined as the practice of pooling the deliveries of all producers for selling purposes; producers receive an initial payment (P_i) upon delivery and a final payment after the pool closes, reflecting the surplus from marketing operations. Case 3 represents CWB marketing of wheat, oats, and barley in those periods when delivery quotas were effectively 'open,' the six years following World War II and several years during the 1960's.

Figure 5

PRICE-QUANTITY RELATIONSHIPS:
ORDERLY MARKETING; POOLED PRICING

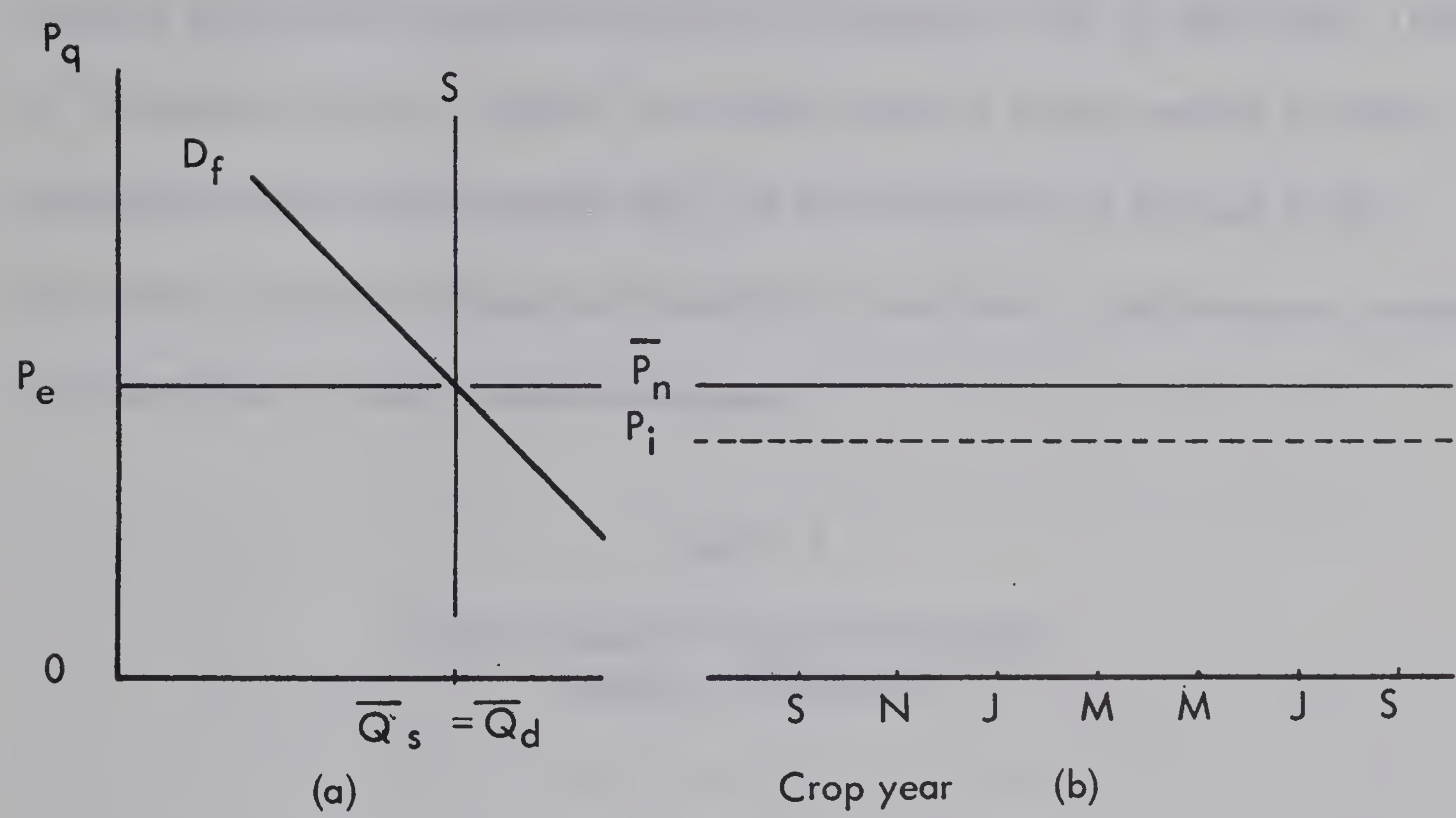


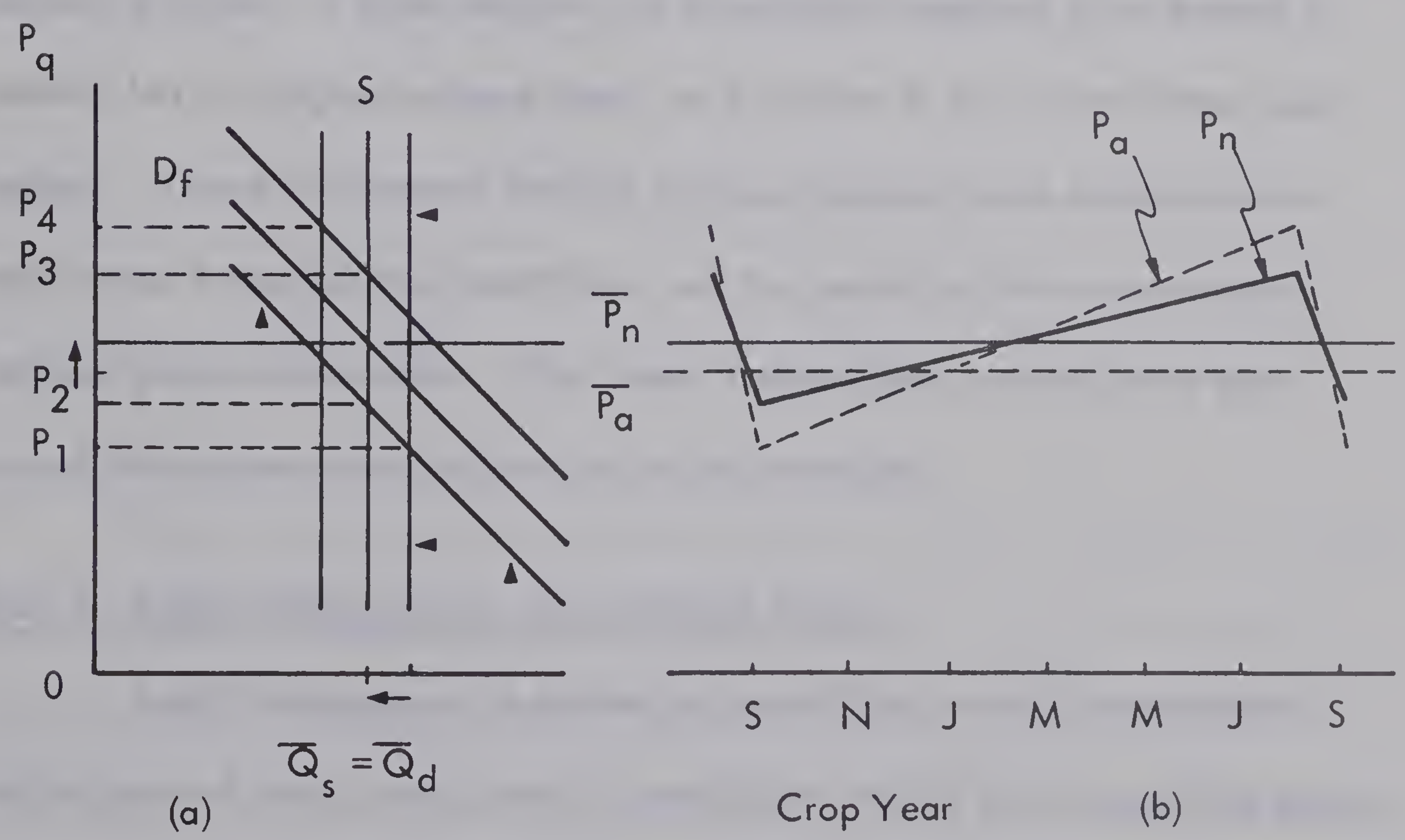
Figure 5 illustrates the economic characteristics of Case 3. Derived demand does not shift because carrying costs are paid according to a fixed schedule out of pool earnings. A seasonal price pattern is eliminated at the farm level. Average return per bushel approximates the average price which would prevail under normal market operations, and carrying charges--income transfers arising from an accentuated seasonal price pattern--are avoided. However, such savings may be offset to the extent that higher storage and handling costs, paid out of the pool account, result from reduced competition and marketing efficiency.

Case 4: Supply Control

Supply control is defined in the present study as the practice of limiting aggregate supply of a particular grain for the purpose of raising average seasonal price above an equilibrium level [Cochrane, 1959, p. 697; Huff, 1970, p. 18; Mehren, 1949, p. 1247]. The effectiveness of supply control in raising aggregate income levels depends upon the price elasticity of demand of the commodity. If price increases and elasticity is less than 1, total revenue increases; if greater than 1, total revenue decreases.

Figure 6

PRICE-QUANTITY RELATIONSHIPS:
SUPPLY CONTROL



Four main devices have been used in Canada for implementing supply control [Walker, 1968, p. 3]. They are: 1) production quotas (Ontario flue cured tobacco); 2) marketing quotas (Ontario fluid milk marketing); 3) input control (LIFT program); and 4) delivery quotas (prairie grain marketing). Delivery quotas are not effective for supply control when they are 'open' but are effective when they are not 'open.' The impact of restrictive quota levels on production is indirect and typically lagged. The principal difference between delivery and marketing quotas is that the quantity of product which can be marketed under the former case is not normally known prior to the production period, whereas under the latter case it is.

Either open market or pooled pricing is possible under either alternative. Under open market pricing in conjunction with either production quotas, marketing quotas, or input controls, an accentuated seasonal price pattern is possible but at a higher average level, as is typical in the United States grain industry. Figure 6 illustrates that the average seasonal price is raised above equilibrium through output restriction, but the possibility of an accentuated seasonal price pattern exists. The impact under delivery quotas is the same except that accentuated seasonal prices are minimized.

Case 5: Supply Management; Open Market Pricing

Supply management is defined as centralized control over quantity and/or price of one or more grains of specialized quality from a specified group of producers to a particular market or markets in a given period [MacFarlane,

1969, p. 312]. Supply management is the sum of orderly marketing and supply control. The two primary price objectives of supply management are 1) minimizing seasonal price fluctuations and 2) raising the level of average seasonal prices. Open market pricing is permitted.

Figure 7

PRICE-QUANTITY RELATIONSHIPS:
SUPPLY MANAGEMENT; OPEN MARKET PRICING

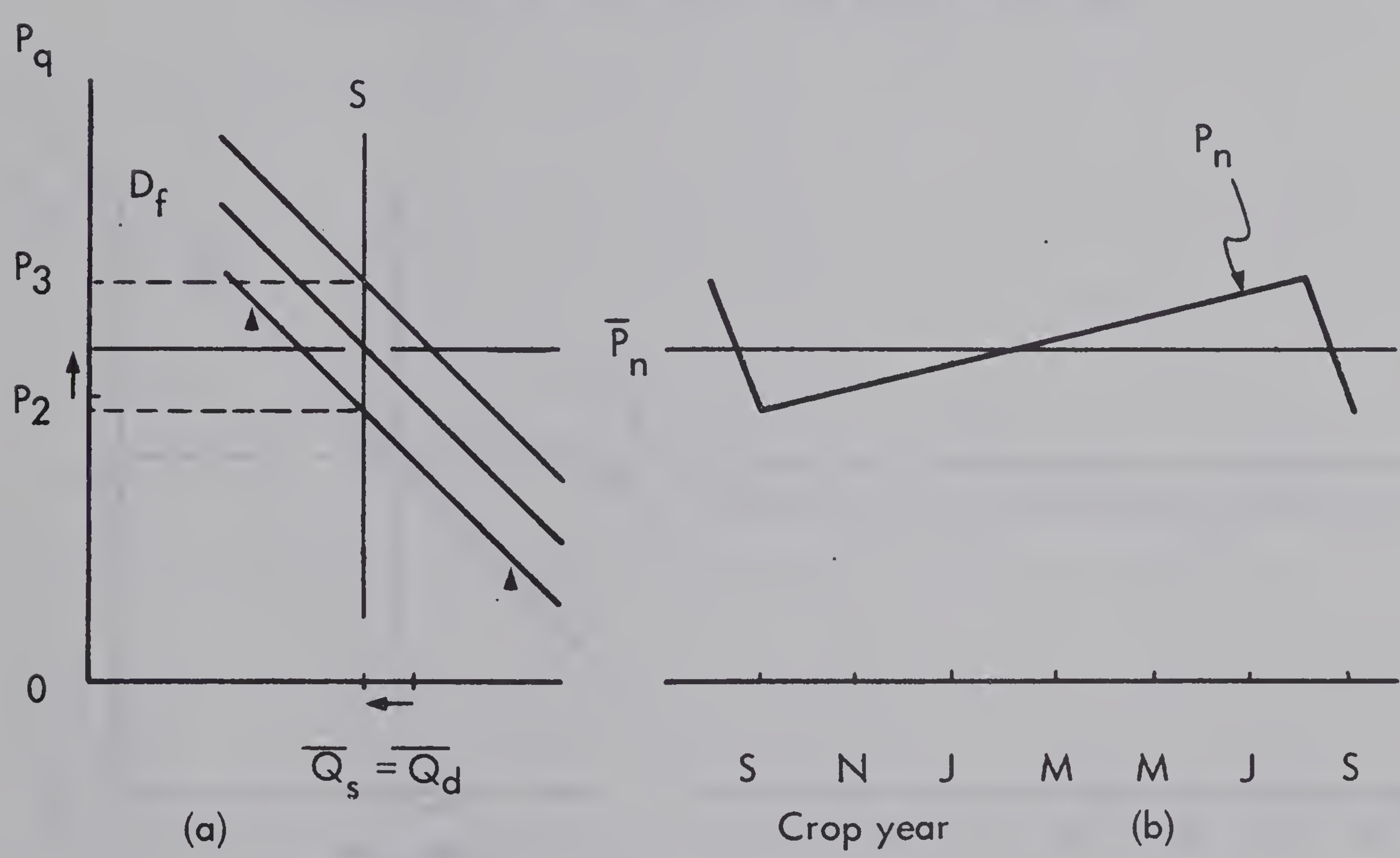


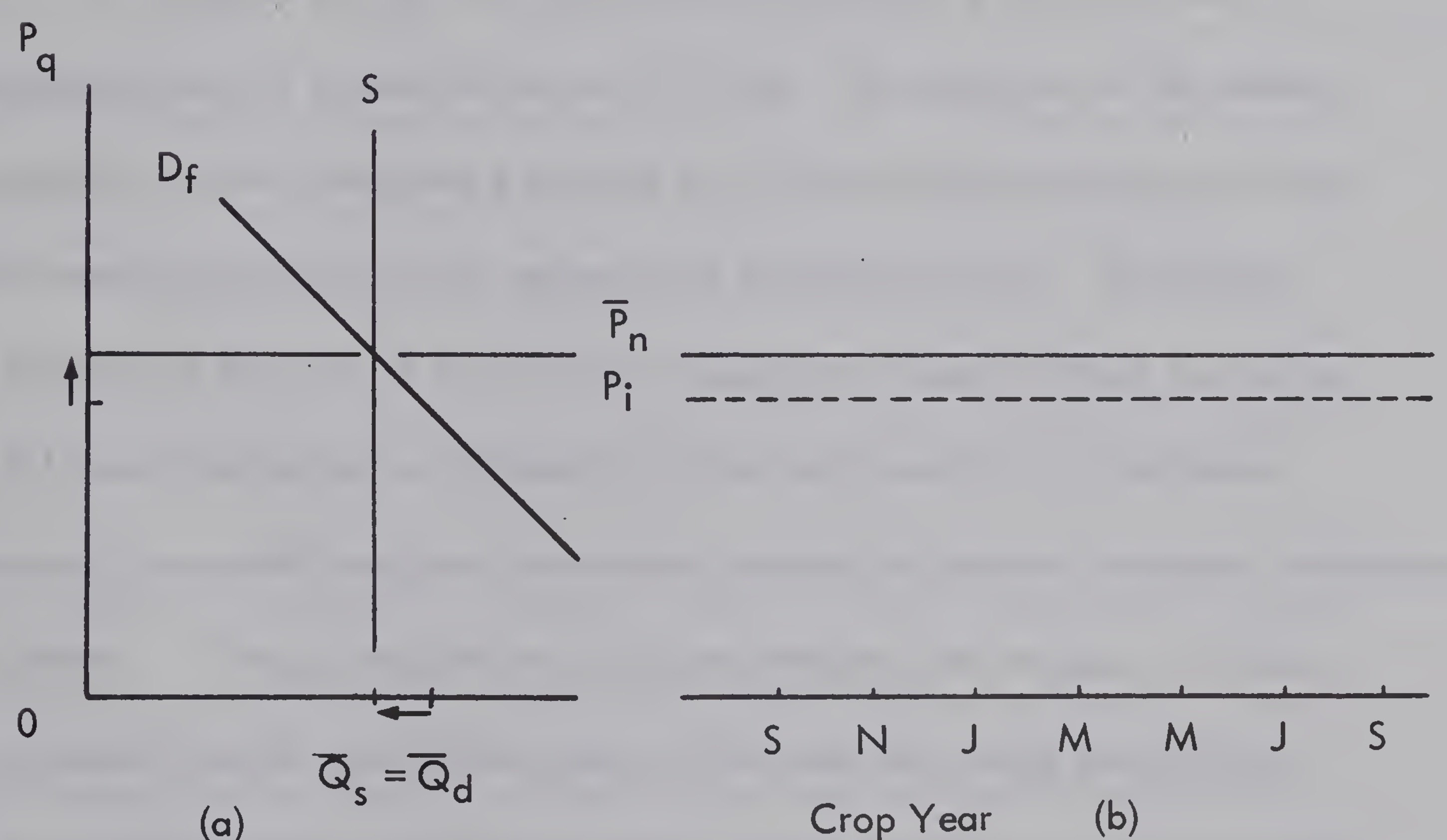
Figure 7 represents the economic impacts of Case 5. Supply is restricted by some means, and price is increased; flow to market is regulated by a delivery quota system, and an accentuated seasonal price pattern is avoided. If flax and rapeseed were restricted in aggregate by the quota system then Case 5 would be an appropriate description of the situation.

Case 6: Supply Management; Pooled Pricing

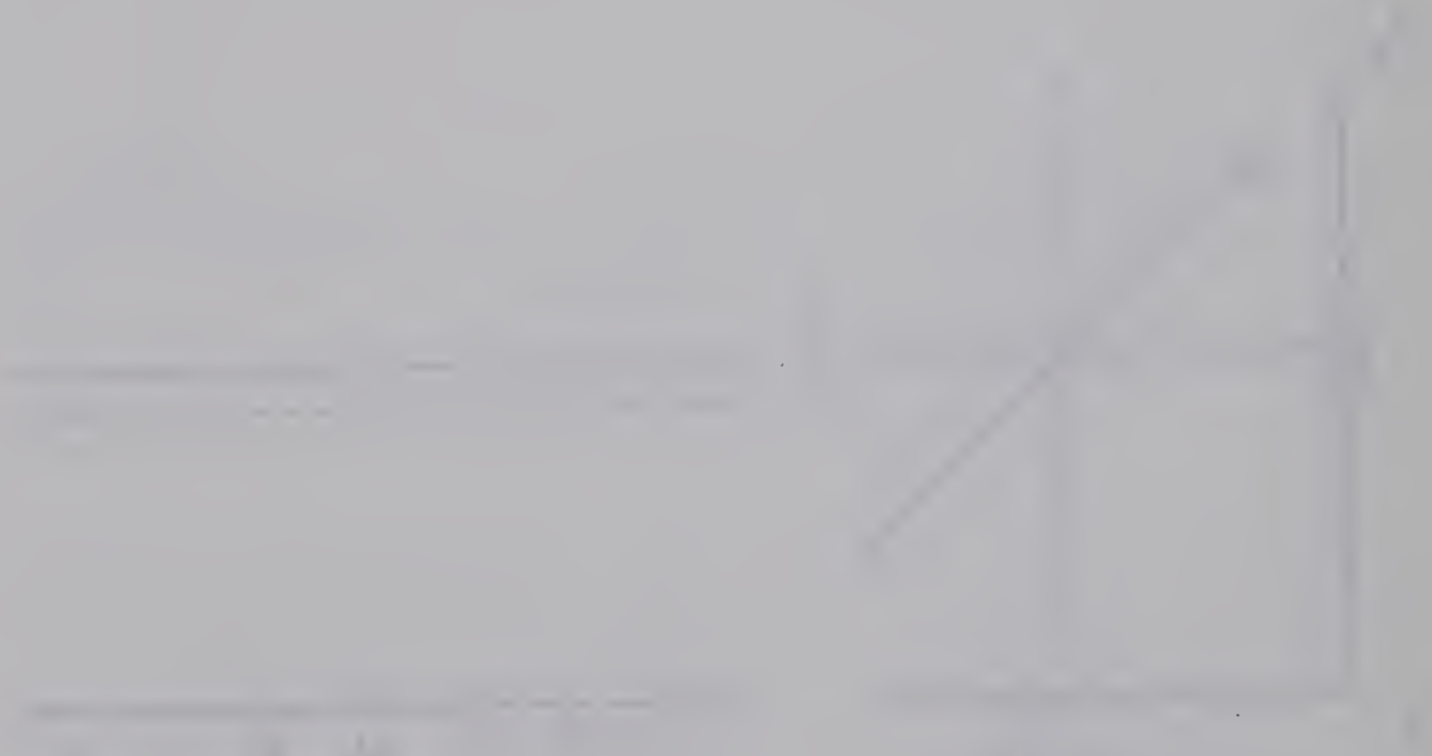
Case 6 is the same as Case 5 except that pooled pricing replaces open market pricing. Quantity is restricted, average price is raised and seasonal price patterns at the farm level are eliminated altogether. The resulting average price is the same as in Case 5. Figure 8 illustrates Case 6.

Figure 8

PRICE-QUANTITY RELATIONSHIPS:
SUPPLY MANAGEMENT; POOLED PRICING



Case 6 necessitates the regulation of supply in relation to demand in the same year, implying the transmittal of future market information to farmers in advance of seeding. Without such information production adjustment lags.



Although the means of supply management may exist, its practice in relation to the supply control component may be ineffective in a lagged production response situation. Case 6 would represent Canadian Wheat Board marketing of wheat, oats, and barley over the past twenty years had it recognized and utilized its supply management power effectively.

Equilibrium and Firm Profit Maximization

Equilibrium

In theory the interaction of market forces operating through aggregate demand and supply functions determines the commodity price level and the aggregate quantity transacted per unit of time. The operation of the perfect competition model postulates a bid and ask process whereby movements along the demand and supply curves approach an equilibrium point. Equilibrium is attained at the point of interaction of supply and demand where the desires of all buyers and sellers with respect to price and quantity of a particular commodity are conflicting but reconciled; except for planned inventory, the market is cleared. Though equilibrium is seldom attained, the tendency is always a movement towards equilibrium, both in the short run, when the positions of the demand-supply schedules are fixed, and in the long run, when changes in any of the constant independent variables cause the curves to shift. The necessary and sufficient condition for short run equilibrium is expressed as [Henderson & Quandt, 1958, p. 96]:

$$Q_d = f(P_q) = Q_s$$

$$\text{or} \quad Q_d P_q - Q_s P_q = 0 \qquad (2\text{-}5)$$

This condition states that a price-quantity equilibrium exists when quantity demanded times price, minus quantity supplied times price, is equal to zero per unit of time.

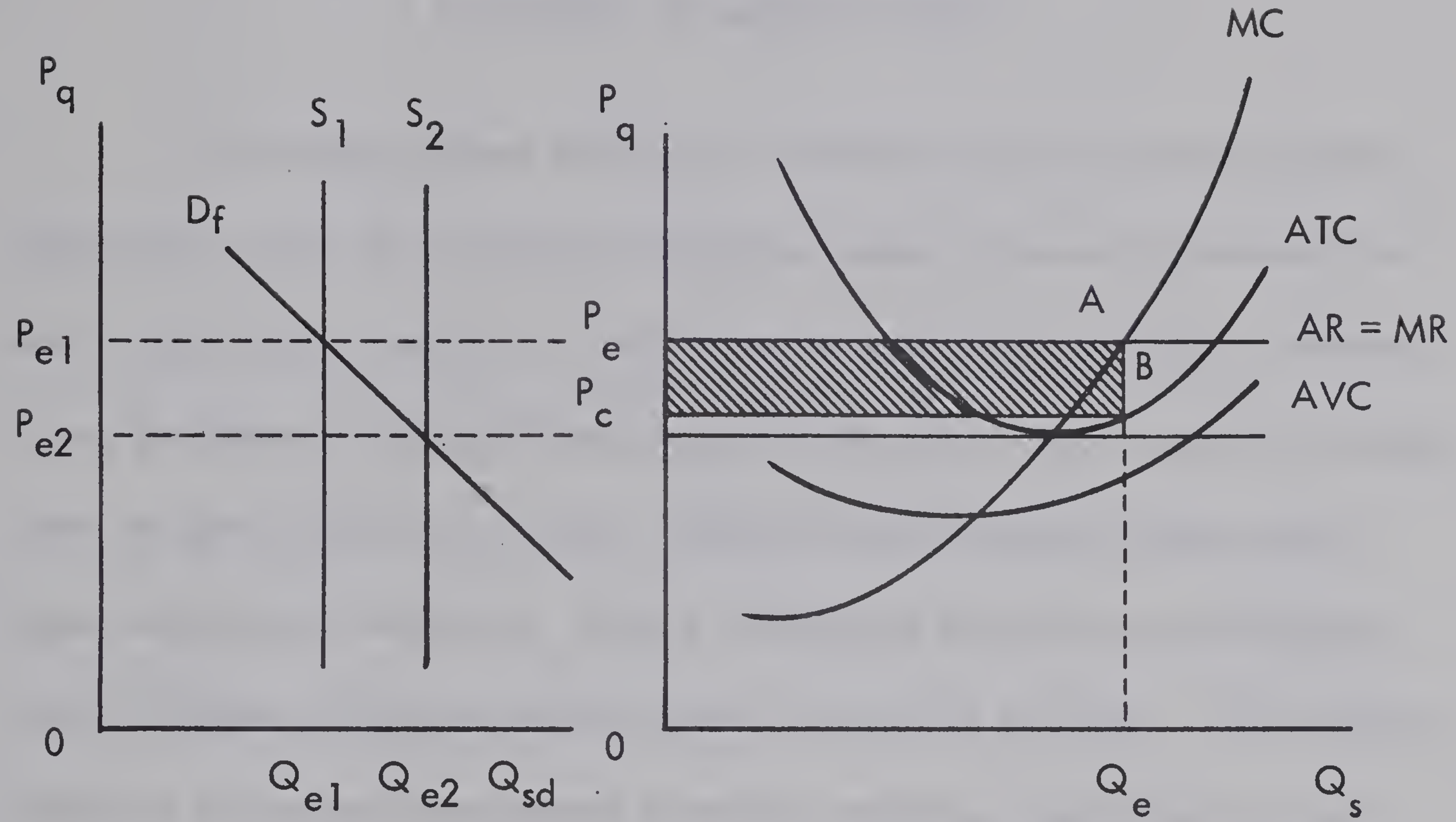
Firm Profit Maximization

Producers may be gross revenue, sales, or profit maximizers or 'satisficers.' In the present study it is assumed that grain farmers are profit maximizers. When the equilibrium market price and firm cost structure are given, profit is maximized under perfect competition where marginal cost is equal to the product price or marginal revenue. Figure 9 illustrates profit maximization where marginal cost (MC) intersects the equilibrium price (P_e) at A. Total revenue is represented by AP_eOQ_e; total cost by BP_cOQ_e; and total firm profit by AP_eP_cB.

If a firm earns a return greater than average total cost, it is earning excess profit or economic rent. Economic rent tends to be capitalized into fixed resources, thus raising opportunity costs. Over time, firms will move toward a zero level of excess profit. Changes in product price, output levels and cost structure each contribute to resource adjustment within the industry. Some firms will experience profits, others losses. Those that continually experience losses will eventually go out of production.

Figure 9

FIRM PROFIT MAXIMIZATION



Source: C. E. Ferguson, Microeconomic Theory (Homewood Illinois: Richard D. Irwin, Inc., 1966), p. 207.

CHAPTER III

A HISTORY OF QUOTA POLICY

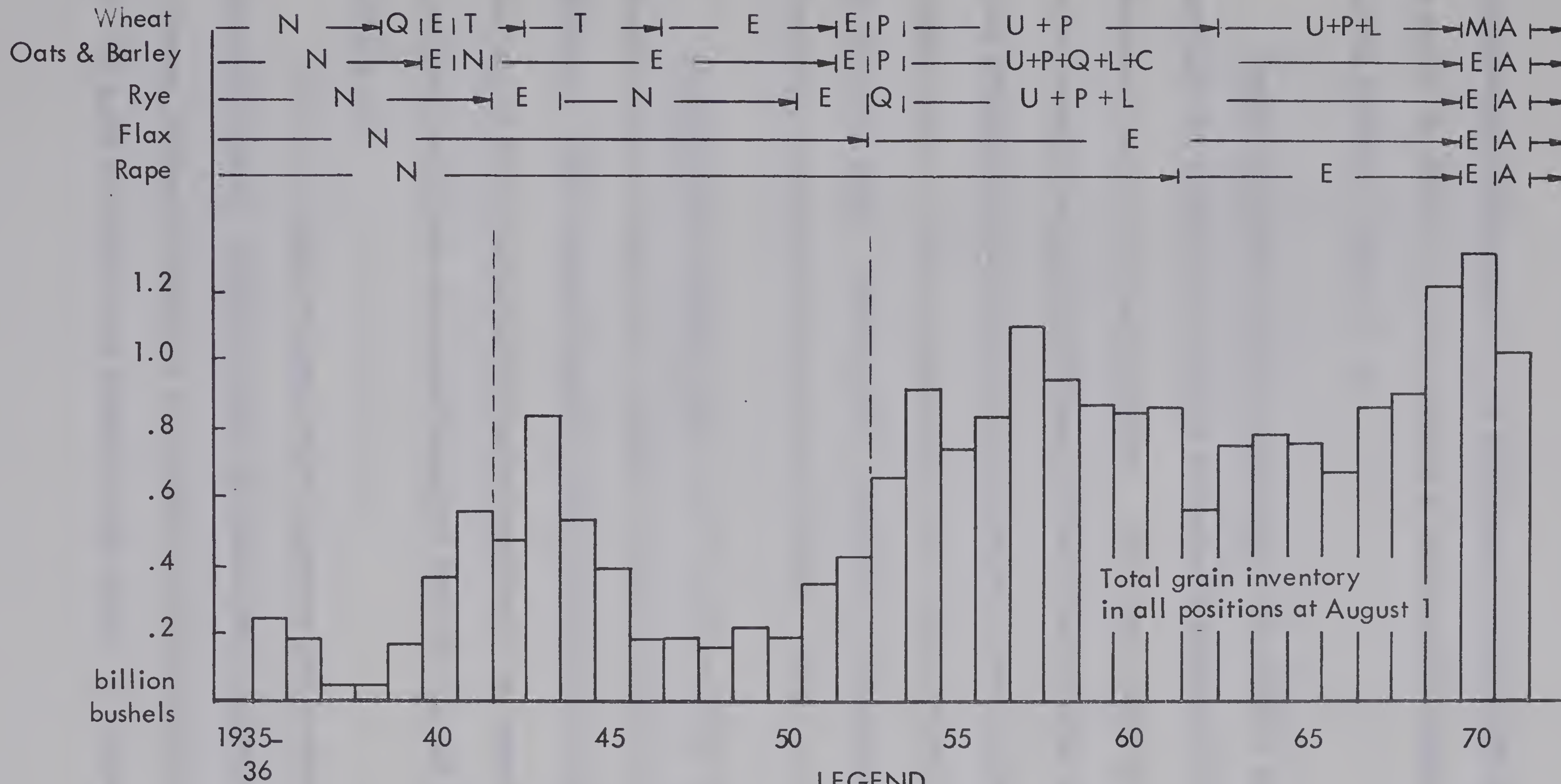
This chapter reviews the origin, evolution, and current status of quota policy with a focus on the reasons underlying change. Figure 10 presents a summary history of quota policy as it relates to the level of the total grain inventory. It may be observed that significant changes in the quota system typically occurred when the grain inventory was high, reflecting demand-supply imbalance and quota restriction of deliveries. History reveals that the quota system changed, not in principle of tying deliveries to land, but only in mechanics. History also highlights the gradual development of orderly marketing, supply control, and supply management in the prairie grain industry.

Origin

The 5,000 bushel limitation--The first semblance of a delivery quota system was introduced by the Canadian Wheat Board on August 1, 1939, with the limitation of Board purchases of wheat to 5,000 bushels from any one producer in any one crop year. The reasons for this action were the expectation of high Board carry-over at the end of the 1938-39 crop year, the prospect of continued world surplus in 1939-40, the limited amount of suitable commercial storage space, and the desire of the federal government to limit its financial liability on the

Figure 10

A SUMMARY HISTORY OF THE CWB DELIVERY QUOTA SYSTEM AND TOTAL GRAIN INVENTORY



LEGEND

N:	No restrictions	E.	Seeded acres	P:	Specified acres	U:	Unit quota	M:	Assigned Smf.
Q:	Fixed quantity	T:	Authorized acres	L:	Supplementary	C:	Carlots	A:	Assigned acres

Board's guaranteed offering price. The 5,000 bushel limitation was dropped at the end of the 1939-40 crop year because of insurmountable administrative difficulties [CWBAR, 1939-40, p. 1].

The commencement of delivery regulations--The 1940-41 Wheat Program gave the CWB power to regulate deliveries by producers at country, mill, and terminal elevators and loading platforms. The primary reason for this action lay in the necessity for equally distributing limited elevator storage space and handling-transportation facilities among all producers in view of a large potentially deliverable surplus. Delivery quotas applied to all commercial deliveries of wheat, oats, and barley. Farmers readily cooperated, and the system operated satisfactorily in promoting orderly marketing [CWBAR, 1940-41, p. 1].

An experiment in supply control--The 1941-42 and 1942-43 crop years saw special attention focused on the problems of unprecedented surplus, storage, and financing. With financial resources urgently required for the war effort, Cabinet agreed that wheat deliveries must be restricted to the amount of wheat that could be sold at home and abroad during the 1941-42 crop year [CWBAR, 1941-42, p. 1].

The 1941-42 Wheat Program limited aggregate prairie wheat deliveries to 223 million bushels. Deliveries under the quota system were based on authorized acreage, defined as 65 percent of a producer's declared wheat acreage in 1940. No quota restrictions were placed on other grains. G. McIvor, Chief

Commissioner of the CWB, noted before the House of Commons Agriculture Committee:

> . . . according to the policy established for 1941-42 the producer was in the position of not only having to have his deliveries regulated during the crop year [orderly marketing] as in 1940-41, but also having a limit on the total amount of wheat which he could deliver [supply control] [H of C, SCAC, 1942, p. 159].

However, in 1941-42, the wheat quota was declared 'open' before the end of the crop year, and the question of supply control became irrelevant.

The 1942-43 Wheat Program limited aggregate prairie wheat deliveries to 280 million bushels. Wheat quotas continued to be based on the previous year's authorized acreage, with oats, barley, and rye based on seeded acreage and with no restrictions on flax and rapeseed. With the four major grains in abundant supply, the crop year ended with delivery quotas at a less than 'open' level and with 350 million bushels in farm storage--four times the amount for any previous year. Supply control via the quota system became fact in 1942-43.

Alternative quota plans never implemented--One alternative endeavoured to incorporate some measure of yield productivity into delivery opportunity. G. McIvor explained to the Agriculture Committee:

> . . . the Board did not wish to have the high yielding areas carrying the wheat which would have had to be carried on farms if we had had a large crop in 1941. The Board felt that after a certain yield per acre was harvested, say seven bushels per acre upward, the farm holdback should be shared by all producers. . . .

> Under this plan the per bushel delivery quota of a producer would be based upon his authorized acreage and the average yield at his delivery point with a sufficient adjustment to prevent total deliveries exceeding 223 million bushels for the West [H of C, SCAC, 1942, p. 161].

This alternative was considered infeasible and according to McIvor was rejected for the following reason:

> Frankly, we now feel that the variation in individual yields per acre at local points is too wide to permit this basis being used except in a year when production is extremely uniform through the West [H of C, SCAC, 1942, p. 161].

Another alternative embodied the concept of deliveries based on some unit other than acreage--a fixed number of bushels per farm or per quarter section, or a fixed number on the first quarter section and a reduced amount on succeeding quarters. The CWB rejected this alternative because it might encourage expanded wheat production or splitting up of farms into quarter section units and complicate transferring the quota upon sale of a farm.

Evolution

Monopoly wheat marketing and open quotas--On September 27, 1943, the CWB became the sole marketing agency for the interprovincial and export sale of all wheat and the intraprovincial sale of wheat for human consumption. Sale of wheat for feed within provinces remained outside the Board's jurisdiction. The Board continued to be a voluntary marketing agency for oats and barley.

Wheat deliveries continued to be based on authorized acreage as defined in 1940 until 1947 when the basis was changed to seeded acreage. Oats and barley were based on seeded acreage; rye on seeded acreage in 1943-44, unrestricted until 1951 then on seeded acreage again; and flax and rapeseed were unrestricted. An aggregate limitation on wheat deliveries was established each year until 1947 when the practice was discontinued in light of recurring buoyant demand. Quota levels reached 'open' status every year between 1943-44 and 1951-52. Thus quota policy operated as a tool of orderly marketing, and supply control was not an issue. Throughout this period when delivery quotas were in effect, an overriding consideration was to secure delivery of as much milling quality wheat as possible to meet domestic and export commitments [CWBAR, 1950-51, p. 6].

The advent of supply control--The crop years 1952-53 and 1953-54 marked a period of painful transition as the buoyant prairie grain industry passed into an era of mounting surpluses. For the first time in the postwar period, the Board was unable to accept all of the wheat, oats, and barley that producers wished to deliver. When the 1952-53 crop year ended, about 220 million bushels remained on prairie farms.

It became increasingly apparent that the existing quota mechanism was inadequate for coping with problems of overproduction. If quotas had continued to be based on seeded acreage, it would have been virtually impossible for producers to deliver their 1952-53 carry-over in the 1953-54 crop year without again

seeding acreage to a crop already in oversupply. The Board accordingly introduced a new concept called 'specified acreage' defined as the total seeded acreage of wheat (except durum), oats, barley, rye, and summerfallow. A general quota was established allowing a certain number of bushels per specified acre on which a producer could deliver either wheat, oats, barley, or rye in any combination. A minimum number of bushels was deliverable at each quota level thus granting small producers a delivery opportunity greater than proportional to their specified acreage.

De facto supply management--Throughout the sixteen year period between 1954-55 and 1969-70, quota policy consisted of a set of specific instruments for achieving an orderly, equitable (equal) flow of grain into commercial channels. Specific policy instruments included the unit, general, advance, supplementary, and special quotas. The unit quota--100 units equal to 3 bushels of wheat, 5 of barley or rye, or 8 of oats per unit or any combination thereof[1]--was designed to equalize returns per unit regardless of the type of grain delivered. The general quota consisted of an incremental number of bushels per specified acre with cultivated perennial forage crops included. Advance quotas provided for delivery of grain in urgent demand or for terminal drying. Supplementary quotas permitted

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[1]The number of bushels deliverable per unit changed several times during the period reflecting relative changes in prices.

delivery on seeded acreage or in fixed quantities, of particular types and grades of grain over the general quota. Special quotas, also delivered over quota, allowed shipment of accepted carlots of malting and pearling barley, manufacturing oats, outstanding stocks owned by estates, and limited quantities for the purchase of registered seed. Flax and rapeseed were based on seeded acreage.

Quotas were declared 'open' in only two of the eighteen years between 1952-53 and 1969-70, meaning that aggregate delivery restriction or supply control, with its indirect lagged impact on production, was an important feature during this period. While supply control was never an officially declared objective of quota policy it appears to have been a residual effect in practice. Likewise, orderly marketing--the matching of grain flow within the crop year with demand specifications--was never officially declared as an objective although it appears to have been operating in practice. The achievement of orderly marketing was often frustrated, however, by the practice of equalizing quota levels across the prairies. As a consequence marketing channels frequently became congested with unmarketable stocks hindering the effective servicing of customers' needs. In general, it is apparent that the objectives of quota policy were never sufficiently well defined to permit the consistent and effective operation of the quota system.

The Current Situation

The early months of 1970 marked the beginning of a period of accelerated examination of grain problems and policies on a wide scale. The LIFT program was designed and implemented to reduce grain inventories sharply in 1970-71. As a component of this program, the quota system was reshaped to provide added incentive for a reduction in wheat production. Wheat deliveries were based on summerfallow and the increase in forage acreage; thus the greater the participation, the greater the delivery opportunity. Quotas for other grains were based on seeded acres plus assigned summerfallow acres.

As a result of the operation of the quota system under LIFT, the report of the Boden Committee on Quota Policy, the report of the Federal Task Force on Agriculture, and the report of the Grain Production Policy Group, a decision was made to implement the assignable acreage quota system in 1971-72. The primary objective of this system is orderly marketing. Farmers may assign their assignable acreage base--seeded acreage plus summerfallow plus several adjustments--to any crop they choose. Delivery rates for each crop will be based on quota acreage, the total acres assigned to each crop. Quota levels will increase sequentially by shipping block, and specific grades may be called for delivery in accordance with demand. An attempt will be made to equalize delivery rates across shipping blocks only if this does not necessitate congesting marketing channels with unmarketable supplies. The control of aggregate supply in relation

to expected demand will be attempted by announcing likely delivery rates and initial payments prior to seeding. In general, it would appear that the practice of supply management, implying both orderly marketing and supply control, has been formally adopted as a policy for the prairie grain industry.

CHAPTER IV

QUOTA POLICY AND PRODUCTION PROBLEMS

The purpose of this chapter is to study the relationships between quota policy and problems in grain production in the prairie provinces. It is assumed that the specified acreage quota system is the operative program of quota policy; however, observations apply equally to any system that ties grain deliveries to the land input. Regression analysis, economic theory, literature sources, and deductive argument are the primary tools of analysis.

Aggregate Production Levels

In a study of Canadian wheat acreage response, A. Schmitz [1968, p. 79] concluded that wheat and flax prices, wheat stocks on farms, and export sales were statistically significant in influencing farmers' wheat acreage decisions. Although R^2_s in the Schmitz study were high, ranging between .76 and .89, it is hypothesized that the inclusion of independent variables measuring year-end delivery quota levels is likely to improve the reliability of estimating equations. *A priori*, if during the production planning period prior to seeding of a crop to be harvested in crop year t farmers expect quota levels not to be 'open' at the end of the current crop year (t-1), they are likely to adjust acreage downward by an amount reflecting the degree of restriction imposed by the quota level.

Conversely, if quota levels are expected to be 'open,' acreage in t is likely to increase, but by an amount reflecting the level of other variables, such as those studied by Schmitz.

It is reasoned that most farmers, in formulating production plans for t, respond to those signals which have meaning at the farm level. Thus quota levels in (t-1) and (t-2), combined with deliveries in (t-1), would seem to be important because they are direct measures, in farmers' minds, of how well sales are progressing, low quota levels and deliveries implying slow sales. Likewise, farm stocks at the end of (t-1) are indicative of the demand-supply relationship, large stocks suggesting supply in excess of demand. The level of CWB initial payments and selling quotations in (t-1) also signifies the relative demand-supply situation, high prices indicating strong demand relative to supply. In the absence of future market information, it is rational for grain farmers to formulate production decisions on the assumption that immediate past and present market trends will continue into crop year t. It is hypothesized that such behavior leads to a typical Cobweb effect--lagged production adjustment in response to changes in price and other market signals--for prairie grain. If the Cobweb effect is operative, then it is reasonable to expect little relationship between aggregate wheat production and sales in crop year t, production being a function of past events and sales being a function of current events.

An important reality, however, is that wheat production in crop year t may not be closely correlated with wheat acreage in t. The impact of yield

variations, arising from stochastic variables such as weather, may significantly alter the functional relationship between acreage and production. For example, in a study of the relationship between weather variables and aggregate prairie wheat production, C.D.V. Williams [1969, p. 99] found that two-thirds of the differential in wheat production between 1961 and 1966 was caused by weather variables reflected primarily through yield differences.

On the basis of the foregoing considerations, three hypotheses are postulated: 1) there is limited correlation between wheat production and wheat sales in crop year t; 2) there is significant correlation between wheat acreage and wheat production in crop year t; and 3) there is significant correlation between wheat acreage in crop year t and a set of independent variables in crop years (t-1) and (t-2). A significant correlation is here defined as a coefficient of determination (R^2) of .50 or more.

Multiple regression analysis was performed on data for the seventeen year period, 1954-55 through 1970-71. This period was selected because 1) the specified acreage quota system was operative throughout, 2) quota levels, except for several years between 1961-62 and 1965-66, persistently ended the crop year at a less than 'open' level, and 3) wheat inventories, although variable, were generally high.

Analysis of the relationship between wheat sales and production in crop year t resulted in an R^2 of .33, with the coefficient of the independent variable, wheat production, significant at the .01 level. The hypothesis could not be

rejected, and it is concluded that there is little correlation between wheat production and sales in t. Two implications follow: 1) Say's Law--prairie wheat supply creates its own demand--is denied. It is inferred, therefore, that on average wheat prices were maintained above an equilibrium or market clearing level during the period studied; and 2) wheat acreage is not adjusted to match supply closely with demand in crop year t, and/or the influence of yield is sufficiently strong to modify the impact of acreage adjustments.

Analysis of the relationships among wheat acreage, yield, and production in t, with production as the dependent variable, resulted in an R^2 of .996. The simple correlations for acreage and yield with production were .613 and .913 respectively. If 100 per cent of the variation in wheat production is accounted for by variations in acreage and yield, then approximately 40 per cent of the variation is due to acreage and 60 per cent to yield. It is concluded that the impact of yield on fluctuations in wheat production is stronger than the impact of seeded acreage, a conclusion consistent with Williams' findings. Thus the hypothesis of significant correlation between wheat acreage and production is rejected. By implication, efforts to influence wheat production through acreage adjustments are subject to wide error because of the stochastic nature of yield. Therefore precision in planned wheat production adjustment necessitates reliable yield predictions.

In testing the third hypothesis, wheat yields were assumed to be constant or at least roughly predictable. Regression analysis was performed on five

independent variables: X_1, the final realized price for No. 1 Northern wheat in store, Thunder Bay, in crop year (t-1); X_2, the eligible delivery quota rate per specified acre in crop year (t-2); X_3, the ending farm carry-over of wheat in crop year (t-1); X_4, the eligible delivery quota rate per specified acre in crop year (t-1); and X_5, the actual wheat deliveries in crop year (t-1). Actual wheat acreage (Y) in crop year t was the dependent variable. All data came from CWB sources. Eligible delivery rates were the sum of the year-end rates under the general quota and rates derived from the conversion to the appropriate specified acreage base of eligible deliveries under unit and supplementary seeded acreage quotas. The analysis resulted in the following linear regression equation:

$$Y = 6.719 + 11.330X_1^{***} + 0.482X_2^{*} - 0.017X_3^{**} - 0.888X_4^{**} + 0.012X_5^{*} \quad [1] \qquad (4\text{-}1)$$
$$\qquad\qquad (3.907) \qquad (0.294) \qquad (0.006) \qquad (0.360) \qquad (0.007)$$

The coefficient of determination (R^2) was .91, and the standard error of estimate was 1.22. All signs, except X_4, were as expected. When X_4 is regressed with the dependent variable alone, the sign is correct, suggesting that the presence of more highly correlated variables caused the sign to reverse. The regression equation is interpreted to mean that 91 percent of the total variation in the dependent variable (Y), is explained by variations in the independent variables. Specifically, with a constant term of 6.72 million acres, a 10 per cent increase

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[1] Confidence levels: *** .01; ** .05; * .10 from one tail t-test.

in wheat price in crop year (t−1) results in an increase of 1.13 million acres; a one bushel quota increase in (t−2) results in a .48 million acre increase; a 100 million bushel increase in ending farm carry-over in (t−1) results in a 1.70 million acre decrease; a one bushel quota increase in (t−1) results in a .89 million acre decrease; and an increase in wheat deliveries of 100 million bushels in (t−1) results in an increase of 1.2 million acres in seeded acreage of wheat in crop year t.

Because R^2 is greater than .50, the null hypothesis--significant correlation between wheat acreage in t and variables in (t−1) and (t−2)--is not rejected. It is concluded that delivery quota levels, along with price, delivery, and farm carry-over variables, were statistically significant in influencing aggregate wheat production levels during the period tested. Therefore, Schmitz's estimates could be improved by incorporating quota level variables. Analysis was not performed on other grains because delivery in the case of oats, barley, and rye, was largely residual to wheat or in the case of flax and rapeseed, was not restricted under the specified acreage quota system.

Supply Management

The foregoing section suggests that quota policy, specifically the level of delivery quotas, is an important factor contributing to a lagged wheat acreage response. However, other variables--price, deliveries, farm stocks--were shown to be important as well. In this respect the Federal Task Force on Agriculture notes:

> Low quotas are said to provide a signal for a cutback in production. The quotas are not the causative factor in this cutback, however, and producers would also feel the basic market pressures without a quota system [MacFarlane, 1969, p. 135].

When yield influences are also considered, it becomes apparent that it is only by coincidence and good fortune that the level of wheat production is congruent with sales in crop year t.

The supply management model (Case 6 outlined in Chapter II) necessitates that, in addition to the practice of orderly marketing, aggregate supply be constrained so that price and total revenue are maintained above an equilibrium level in crop year t. Evidence suggests that the CWB has utilized delivery quota policy as a means of fulfilling its supply management role. However, the supply control component appears to have been less than well handled, as evidenced by the limited correlation between production and sales in crop year t and the problem of recurring, unmanageable surpluses. In addition, the supply management strategy used for wheat appears to have also been applied to feed grains by restricting deliveries by quota to raise prices. A priori, if feed grains are more price elastic than wheat, then the appropriate strategy for raising income from feed grain sales may be instead to lower price and increase volume.

In any event, for quota policy to operate effectively as a vehicle of supply management, it must be accompanied by reliable market forecasting. Expected sales, prices, and delivery quota levels must be communicated as market information to farmers prior to seeding if they are to respond to future instead of past,

market needs. A market forecasting program needs the support of an inventory management program, providing both reserve grain and slack storage, to compensate for much of the inevitable forecasting error. An integrated forecasting, inventory, and quota program would go far toward matching supply with demand in a supply management sense.

Production Efficiency and Productivity

Several theoretical impacts on production and resource allocation efficiency resulting from the operation of the specified acreage quota system, can be inferred using Figure 2, Chapter II. Suppose land (specified acres) is measured on the X_2 axis and capital on the X_1 axis of the isoquant-isocost contour surface. Assume initially that the delivery rate per specified acre is sufficiently high for total production to be marketed on quota. Then for a given number of specified acres $\overline{X}_2$, X_1^o quantity of capital is required to achieve optimum resource combination, or least-cost level of output q_2. Now assume that the delivery rate falls in such a way that the total quantity to be marketed is represented by isoquant q_1. If the farmer wishes to produce only for the quota market and does not wish to build up an inventory, then production must also decline. To be eligible to market a q_1 level of output, the original number of specified acres $(\overline{X}_2)$ must be retained in the production process, but the amount of capital required falls to X_1^1. In a practical sense this means that the farmer either increases the proportion of land summerfallowed or uses fewer yield increasing inputs--

fertilizer, chemicals, etc. Thus the first observed impact of land tied delivery quotas is the inducement of land extensive farming practices at the expense of higher yield technology. The second observed impact is inefficient resource combination with more land and less capital employed than the value of their respective marginal products would suggest. A lower total budget outlay is required when the quota is 'open,' but the outlay is higher than would be required if resources were combined in least-cost ratios at the new level of output. If resources were being combined efficiently at the q_1 level of output, X_1^2 units of capital would be used in combination with X_2^2 units of land.

When land is constant at $\overline{X}_2$ and output is restricted via quota, the results are lower total product, higher marginal and average products, restriction of capital utilization, higher average total and fixed costs, and lower marginal and average variable costs, all of which are out of balance with efficient resource combination. The focus of production shifts left in stage II and, if the quota is sufficiently restrictive, may shift into stage I (irrational) of the firm's production function. Farm profit is lower, and if productive activity is constrained, so that average total cost exceeds the price level, the firm incurs losses.

All these observed impacts result from retaining land in the production process in excess of requirements in order to maintain a delivery quota base. There is strong incentive to purchase land to increase the delivery base, thus attributing to marginal land a greater value than its physical productivity warrants. In the longer run, in the presence of restrictive quotas producers cannot afford

to restrict production on their land base. Hence, they will implicitly target for least-cost resource combination, and output surplus to quota opportunities will be either fed to livestock or sold off-quota at lower prices. Therefore, a restrictive, land based quota system tends to induce diversification of production whether or not such a practice accords with the optimum use of resources or with farmers' desires.

In the absence of restrictive quota levels, the previously mentioned observed impacts are inoperative, and the attainment of production efficiency is limited only by the availability of capital and labour and the level of managerial skills.

Productivity is defined in economic terms as:

> The output of a unit of a factor of production in a stated period . . . . Strictly, the term is best related to a single factor; when a group of factors, as in a firm, is being analyzed, it is more common to use the term 'efficiency' [Seldon, 1965, p. 339].

With respect to individual factors, the productivity of labour may be measured as the output per man per year (or some other time period); the productivity of land may be measured as the output per acre per year; and the productivity of capital may be measured as the output per dollar of invested capital per unit of time. When a factor of production becomes more productive, a smaller amount of input is required per unit of output.

For a package of resources such as a grain farm, productivity measures the efficiency with which resources are converted into grain. Higher productivity may mean larger output, lower costs, lower prices, greater profits, more employment

and greater investment, all of which contribute to a higher level of economic welfare [Fabricant, 1963, p. 24]. For agriculture, the Economic Council of Canada states:

> The relevance of high productivity gains in agriculture is that they are essential in the longer run to the achievement of increased levels of income [ECC, 1968, p. 83].

Although the growth rate in agricultural labour productivity between 1947 and 1967 was roughly comparable between Canada and the United States (5.5 and 6.0 per cent respectively) the substantial gap in absolute levels of productivity widened [ECC, 1968, p. 88]. If the rate of increase in United States agricultural productivity were to remain constant, Canadian agricultural productivity would have to increase by more than half to 8 per cent per year in order to close the productivity gap by 1990. Agricultural labour productivity in the United States has gained more and reached a higher level because of a more rapid rate of increase in the use of yield technology than in the use of machine technology. In the United States the value of marginal product is highest for farm mechanization inputs, but in Canada it is highest for yield increasing inputs, such as fertilizers and pesticides. Because the direction of resource expenditure has been the reverse of what was expected in both countries in terms of marginal returns, the ECC concluded that non-economic factors were critical.

Part of the explanation stems from the difference in climate and the availability of high yielding varieties. However, the most decisive influence on productivity growth has possibly been government supply control policies:

> Faced by excess production in the late 1950's, the U. S. government paid farmers to take land out of grain production. This in turn is likely to have induced farmers to increase crop yields on the remaining acreage and to feed more grain to livestock. In addition, there was provision to sell surplus grain directly to the government. The Canadian government, on the other hand, utilized a system of grain delivery quotas essentially based on grain acreage. This in turn may have induced farmers to enlarge their farm acreage and invest more heavily in mechanization [ECC, 1968, p. 90].

It is likely more than coincidence that yields of the Canadian grains most restricted by the CWB delivery quota system during this period--wheat, oats, barley, and rye--lagged significantly behind yields of corresponding U. S. crops in 1967 although they were greater than or the same in 1947. In contrast, those Canadian grains which either were not marketed under quota--corn and soybeans--or were marketed under quota but not restricted by it--flax--were ahead of or on par with U. S. yields in 1947 and remained so in 1967.

It has been suggested by McLeod [1970] and Lang [1970] that a productivity factor be built into delivery quotas so that yield productivity may be rewarded and so that the burden of carrying surplus farm inventory is distributed more evenly across the prairies. It is assumed that this approach implies the adjustment of delivery rates by an index reflecting crop yields at various shipping points. One of the difficulties with a yield index is that land productivity is not necessarily correlated with total farm productivity; it is possible to think of highly productive farms with low yields and vice versa. Two more dramatic approaches for stimulating and rewarding productivity are: 1) the removal of quotas from land; and 2) the elimination of quotas altogether.

Interregional Competition and Land Use

In response to the quota equalization aspect of specified acreage quota policy, the production of various grains has tended in recent years to be distributed relatively evenly across the prairies, in contrast to the U. S. where there is clear demarcation of production and land use patterns. The unique prairie land use pattern arises from the restrictive aspect of quota levels, which discourage commodity specilization and encourage diversification on all farms, regardless of production efficiency, soil capability, or producer preference. In essence, proportional allocation of demand in relation to land contributes to inefficient interregional resource combination; some degree of comparative advantage is transferred from low to high cost producers.

Apart from short run social adjustment costs, a system of perfect interregional competition is more economically efficient because low cost farmers produce to capacity (maximizing economies of scale) and high cost producers go out of commercial grain production. Spatial competition permits least-cost production of a limited aggregate demand. In a recent study, Interregional Competition in Canadian Cereal Production, W. J. Craddock estimates the economic costs of proportional demand (production) distribution versus a system in which spatial competitive equilibrium is achieved:

> The cost of producing and distributing total cereal requirements under the assumptions of Model 8 is $626 million compared with $606 million for Model 7. This increased cost of $20 million is the annual economic loss if crop acreage is

> reduced proportionally in all regions compared with the removal of only uncompetitive land from production [Craddock, 1970, p. 79].

While $20 million is not very large in relation to total costs, it does highlight some of the costs of inefficient interregional resource combination resulting from the operation of the specified acreage quota system. Craddock suggests that the figure is low because it does not include all production costs or the social cost of underemployed resources.

It may be inferred that similar economic costs would accrue under any quota system which prorates demand and production in relation to land. In general, any system for allocating demand that enhances interregional and interfarm resource mobility, facilitates optimum resource combination within farms, and maximizes utilization of soil physical capability, may be expected to lower aggregate grain production costs.

Economic Rent and Land Values

In theory and practice there is a positive functional relationship between economic rent and the value of land. Economic rent is defined as 'the excess value of the whole product . . . above what is necessary to pay the wages of labour and the profits of capital employed in cultivation' [Barlowe, 1958. p. 159; quoted from T. R. Malthus, 1836, Principles of Political Economy (London: William Pickering), p. 136]. In other words, economic rent is the residual or surplus income accruing to a firm after the cost of maintaining all

resources in the production process is deducted from total revenue. Economic rent tends to be capitalized into the value of fixed assets, such as land.

If non-production related factors (e. g., proximity to a large city) are assumed constant, the value of land employed in grain production is a function of the present value of the expected stream of economic rent (assuming a return on the actual purchase value of land is excluded from cost calculations). This is called the 'income capitalization' approach to land valuation, and when an income stream is assumed to continue in perpetuity, it is quantified by the formula [Barlowe, 1958, p. 169]:

$$V = \frac{a}{r} \tag{4-2}$$

where: V = the estimated value of land;

a = the average annual economic rent;

r = the capitalization interest rate.

Although there are problems in estimating future income streams and determining appropriate discount rates, this formula may be used to assess the impact of quota policy on land values.

In general, as quota levels become more restrictive, deliveries, profits, and land values fall. Conversely, land values rise when quotas are less restrictive. Marketing output, surplus to quota opportunities, off-quota is likely to offset only part of the reduction in profits and land values because of lower off-quota product prices.

It may be hypothesized that the equalization of quota levels contributes to a tendency toward land value equalization across the prairies, high productivity land valued less and low productivity land valued more than would occur under spatial competitive equilibrium. Such an asset transfer effect arises from an interregional shift in delivery opportunities and residual income streams under quota policy. If the land value equalization tendency is not apparent in asking prices (e. g., some high productivity land), it may be the result of producer speculation that future market opportunities will absorb the land's total productive capacity. From observation of the current impact of restrictive quotas on land values, marginal land appears to be overpriced relative to its physical capability for grain production. More highly productive land appears to be underpriced, but at the same time overpriced in relation to the economic rent obtainable from prevailing sales opportunities.

CHAPTER V

QUOTA POLICY, MARKETING, AND INCOME PROBLEMS

The purpose of this chapter is to study the relationships between quota policy and problems in the marketing of prairie grain. Implications of quota policy for the level, stability, and distribution of income from grain are also explored. Although observations relate primarily to the operation of traditional CWB quota policy within the context of 'perfect' derived demand allocation, similar observations may be inferred for other institutional forms of allocation. As in Chapter IV, economic theory, literature sources, and deductive argument are the primary analytical tools.

Market Structure

Market structure in relation to the prairie grain industry refers to the organizational characteristics of the three main markets in which producers directly participate as sellers. These markets are: 1) the Quota Regulated Canadian Wheat Board market (QRCWB); 2) the Quota Regulated Non-Canadian Wheat Board market (QRNCWB); and 3) the Non-Quota Regulated market (NRQ).

<u>QRCWB characteristics</u>--Under the CWB Act all wheat, oats, and barley produced in the prairie region going into interprovincial and export

channels for all uses or into intraprovincial channels for human consumption are handled by this market.[1] Each commodity is homogeneous by grades determined at country elevators and confirmed at random by the Canadian Grain Commission (formerly the Board of Grain Commissioners). About 200 thousand prairie grain producers sell to the Canadian Wheat Board, a federal government agency behaving as a monopolist in the domestic food market and as an oligopolist in the export market. Elevator companies and railways function as agents of the Board on a fee basis, grain merchandizers as agents on a cash or deferred pricing basis.

Though access to the QRCWB market is regulated by the delivery quota system operated by the CWB, delivery is voluntary. When grain is delivered, it moves into an annual pool, and the producer receives an initial payment, varying among producers according to grade and distance to port terminals. Any surplus from sales of pooled grain is paid to producers as a final payment.

QRNCWB characteristics--All rye, flax, and rapeseed produced in the prairie region and moving into commercial handling facilities enter this market.[1] Each grain is homogeneous by grades established at country elevators or processing plants and inspected randomly by the Canadian Grain Commission. About half of all prairie grain producers participate as sellers, facing about a dozen major buyers--cooperative and line elevator companies and local grain processors.

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[1] On April 21, 1971 the federal government served notice of intent to introduce legislation placing rye, flax, and rapeseed under the CWB (QRCWB market). The effect will be elimination of the QRNCWB market.

Access to the market is regulated by the CWB quota system, but delivery is voluntary. Upon delivery farmers receive a daily 'street price,' prorated by grade and transportation charges and determined collectively by buyers in relation to futures prices on the Winnipeg Grain Exchange.

NQR characteristics--This market handles grain moving to prairie feed mills, grain transferred to other farms or consumed within farms as livestock feed, and grain used for seed. Off-quota grain is graded at the point of sale but not officially confirmed by the Canadian Grain Commission. In reality there are three NQR markets within the prairies because feed grain may not move across provincial boundaries, except under CWB authority. Most producers participate as buyers or sellers, and several hundred feed mills and seed processors participate as buyers.

Market participation is voluntary, but aggregate demand is limited by the size of the prairie livestock population and the availability of forage. Because no organized market exists, transaction prices are determined by private negotiation between buyer and seller. Price levels approximate the initial payment for CWB pooled grain with deviations reflecting the relative demand-supply situation in each provincial market.[1] Supply in the NQR markets varies

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[1]Off-quota grain prices are collected by the CWB but not published; therefore, it is difficult to verify empirically the relationship between QRCWB and NQR market prices.

Table 2

DISPOSITION OF PRAIRIE GRAIN PRODUCTION BY MARKET STRUCTURE TYPE AND GRAIN
(1964-65 to 1968-69 Average)

Commodity	Unit of Measure	Market Structure Type QRCWB (1) (%)		QRNCWB (2) (%)		NRQ (3) (%)		Ending Farm Inventory Adjustment (4) (%)		Production (5) (%)	
Wheat	M. bus.	(80)	521		0	(21)	89	(68)	34	(55)	644
	[%]		[81]				[14]		[05]		[100]
Oats	M. bus.	(06)	41		0	(46)	193	(04)	+02	(20)	236
	[%]		[17]				[82]		[01]		[100]
Barley	M. bus.	(14)	90		0	(31)	131	(28)	+14	(20)	235
	[%]		[38]				[56]		[06]		[100]
Rye	M. bus.		0	(19)	8	(01)	5		0	(01)	13
	[%]				[61]		[39]				[100]
Flax	M. bus.		0	(39)	17	(.5)	2		0	(02)	19
	[%]				[89]		[11]				[100]
Rapeseed	M. bus.		0	(42)	18	(.5)	3		0	(02)	21
	[%]				[86]		[14]				[100]
Total	M. bus.	(100)	652	(100)	43	(100)	423	(100)	+50	(100)	1,168
	[%]		[56]		[04]		[36]		[04]		[100]

Table 2

DISPOSITION OF PRAIRIE GRAIN PRODUCTION BY MARKET STRUCTURE TYPE AND GRAIN
(1964-65 to 1968-69 Average)
(continued)

Commodity	Unit of Measure	Column (1)	Column (2)	Column (3)	Column (4)	Column (5)

Source: Column (1): The Canadian Wheat Board, "Producer's Marketings--Western Canadian Grains," Annual Report, 1968-69. (Winnipeg, Manitoba: CWB, March 1970), Addenda, p. 4, Table IV. [These data are assumed to be equivalent to producer deliveries on-quota into commercial channels.] Column (2): Ibid. Column (3): Equals (5) - [(1) + (2) + (4)]. [These data represent all off-quota grain consumed by livestock, sold to feed mills, and used for seed.] Column (4): Ibid., "Canadian Wheat, Oats and Barley Supplies and Disposition," Addenda, pp. 6-8, Tables VII, VIII, IX. [The annual net addition to ending farm carry-over at July 31 equals actual ending farm carry-over at July 31, 1969 minus the five year average ending carry-over, divided by five.] Column (5): Ibid., "Production of Principal Grains in the Prairie Provinces," Addenda, p. 3, Table III.

inversely with the level of on-quota delivery opportunities.

Relative importance of markets--The average annual disposition of production of the six major prairie grains by market structure type is illustrated in Table 2. The left hand (%) column portrays each grain as a proportion of all grain handled by each market, the right hand [%] column, the proportion of total production of each grain handled by each market. For example, it is observed that an average of 644 million bushels of wheat is produced, representing 55 percent of total prairie grain production. Of this amount, 521 million bushels, or 81 percent, are marketed on-quota to the Canadian Wheat Board, 89 million bushels, or 14 per cent, are disposed of off-quota, and no wheat is sold in the QRNCWB market. Thirty-four million bushels, 5 percent of annual production, are added to farm inventory each year during the period. In addition, of the 652 million bushels of grain received for CWB account, 80 percent is wheat, 6 percent oats, and 14 percent barley. Only 21 percent of the 423 million bushels of grain disposed of outside the quota system is wheat.

Of 1,168 million bushels of grain produced on average, 56 percent is marketed in the QRCWB market, 4 percent in the QRNCWB market, and 36 percent in the NQR market. A residual of 4 percent is added to ending farm carry-over each year. The NQR market is especially important for oats and barley, handling 82 and 56 percent of production respectively.

Market structure implications--Quota policy is an important factor determining market structure types and the amount of grain handled by each;

market structure has implications for pricing and flow performance. In the quota regulated markets more orderly commodity flow, greater price stability, and higher price levels (compared with the open market) are apparent. However, it is postulated that the 'spin-off' effect causes greater disorder in the NQR and livestock markets because they act as a buffer between variations in production and commercial sales.

Quota induced surplus (supply residual to commercial needs) in NQR contributes to depressed off-quota grain prices (relative to on-quota prices) and tends to stimulate livestock production. The opposite effect occurs under quota induced shortages in NQR. In addition, quota equalization in QRCWB tends to encourage a larger number (relative to the open market) of grain producers to be 'inners and outers' in livestock, contributing to accentuated cycles in livestock production. Hog production (with abnormally high supply and low prices) in 1959-60 and 1970-71 demonstrates this point. Supply management of commercial grain via quota policy and artificial market structure does not seem to contribute to 'Pareto optimum' within the agricultural industry; NQR market participants and livestock producers are, in general, made worse off.

Within existing market structures, two actions would tend to improve the performance of the NQR market: 1) the regular publication of area transaction

prices and supply situations; and 2) the removal of restrictions on interprovincial feed grain movement within the prairies. The removal of restrictions on feed grain movement across Canada or the placing of existing NQR market transactions under CWB jurisdiction implies significant change in current market structures, the ramifications of either move being a suitable topic for further detailed study.

Allocation of Derived Demand and Market Channels

There are several ways of distributing derived demand for commercial grain and the use of marketing channels (elevators and railways) among producers. The purpose of the present section is to examine the realities and implications of open market allocation versus delivery quota allocation against the background of 'perfect' allocation in the context of the economic model of perfect competition.

'Perfect' Allocation

Under perfect competition the interaction of demand, supply, price, and farm cost structures matches the seasonal flow of product from producers with demand requirements. Interaction of aggregate demand and supply determines the market price level. Individual producers implicitly compare their average production costs with the market price, and if an acceptable profit can be realized or the market price is not expected to improve, they will sell. On the other hand, if the market price is not acceptable or is expected to increase,

they may elect to store for a period of time.

In theory, aggregate demand and the use of marketing channels is 'perfectly' allocated if each producer sells when the market price is, on average, equal to his marginal cost of production. Those producers who continually experience losses will be forced in the long run to cease production or shift resources to the production of alternative commodities. Perfect competition is an impersonal, objective, and efficient means of allocating demand; it insures that production occurs at least cost, that opportunity costs of resources retained in production are covered, and that consumers pay a fair price in relation to production costs. The potential for Pareto efficient product and resource allocation exists.

Open Market Allocation

In the theoretical version of the open market (Case 1) discussed in Chapter II, it was observed that the possibility for an accentuated seasonal price pattern exists, arising from supply-demand imbalance and resulting in a lower weighted average seasonal price than would be expected if monthly supply corresponded perfectly with monthly demand. Five other factors affect the nature of perfect competition and influence demand allocation to specific producer subsets. These factors are: 1) proximity to elevators; 2) product quality; 3) delivery volume; 4) elevator operator-farmer rapport; and 5) convenience.

Elevator operators are likely to prefer purchasing from producers who

are located close to elevators, can supply large volumes of consistent quality, are on good terms with the operator, and have large trucks. Producers who do not fit these criteria may find that demand is fully supplied before they have an opportunity to deliver or may only deliver at a substantial discount in price. The operation of the open market is subject to 'kickbacks,' 'downgrading,' and complaint from producers of unfair treatment. Even with these imperfections the system tends toward a high degree of efficiency in demand allocation, for elevators buy only those volumes and qualities they can resell at a profit. In the long run production efficiency is also enhanced because only least-cost producers are able to compete successfully.

Delivery Quota Allocation

Producer agitation for fair treatment and correction of open market imperfections are two reasons for demand and market channel allocation via delivery quotas, both being distributed in proportion to land farmed (under CWB quota policy). All producers share, regardless of production costs, quality, volume, location, convenience, or elevator-operator rapport. There is some shift in market shares to producers characterized by high costs, inappropriate quality, low volumes, and long hauls. Convenience is no longer an important factor. Elevator operators are required to deal with more customers more times during the crop year, and producers are required to clear snow and operate equipment more times in response to sequentially increasing quota levels. On the other hand, the practices

of 'kickback' and 'downgrading' are virtually eliminated.

In general, delivery quota allocation is more objective, orderly, and equal than the open market. The cost is measured in terms of reduced production efficiency (marketing opportunities are transferred to higher cost producers) and reduced marketing efficiency (widely dispersed elevators and trackage are maintained to service widely dispersed producers). Whether reduced efficiency can be tolerated in the long run depends on the ability of prairie grain producers to compete successfully in export markets without experiencing a gradual erosion of land values, reflecting a reduction in economic rent.

Marketing Efficiency

Marketing efficiency in relation to the prairie grain industry is comprised of exchange and operational efficiency. An improvement in either or both leads to increased marketing efficiency. Exchange efficiency refers to the ability of the price mechanism to respond to and reflect accurately changing demand-supply circumstances. Product and resource allocation are enhanced by a high degree of exchange efficiency, its attainment being dependent upon the presence of widely communicated, reliable market information and the absence of institutional constraints.

Exchange efficiency appears to be low in all three grain markets for the following reasons: 1) In the QRCWB market, initial payments, set by the federal government, normally bear little relationship to demand-supply circumstances, and delivery quotas mask price signals that allocate demand; 2) In the QRNCWB

market, quotas and 'street' prices, related to futures prices, jointly allocate demand, but both 'street' and futures prices may be manipulated so that demand information is not always conveyed accurately to producers; 3) In the NQR market the absence of public information on transaction prices prevents the efficient flow of grain to local demand centres.

Operational efficiency in the grain industry is defined as the handling/capacity ratio for elevator and transportation facilities, a low ratio signifying low operational efficiency. The relationship between quota policy and operational efficiency in commercial channels must be examined in conjunction with four other factors: 1) the boxcar shipping order system; 2) fixed below cost country elevator handling rates; 3) fixed above cost elevator storage rates; and 4) fixed below cost Crow's Nest rail freight rates for export grain [Channon, 1969, pp. 87-101].

The important relationships between the level of operational efficiency in grain market channels and these four factors are recounted by A. D. McLeod [1969, p. 6], H. V. Walker [1968, p. 87], E. W. Tyrchniewicz and O. P. Tangri [1968, p. 87], and D. Zasada [1970, p. 58]. In his empirical study of Manitoba country elevator costs, Zasada found that the existing handling/capacity ratio ranged between 1.6 and 3.2 with an average of 2.4. He calculated that this ratio must be increased to at least 5 if a high level of operational efficiency is to be achieved.

The causal interrelationships among the factors are outlined as follows.

Shipping orders are allocated each month by the CWB to elevator companies on the basis of aggregate business over the previous twelve month period. Elevator companies distribute shipping orders to their agents in accordance with estimated need. Boxcars to fill shipping orders are placed by railways on order from elevator agents, so long as a sufficient number of boxcars are ordered along a rail line to justify a train. Delivery quotas are raised at shipping points by the CWB when available elevator space is sufficient to accommodate much of the grain likely to be delivered at each quota level. Because aggregate shipping potential possessed each week by elevator companies relates to historical business rather than to current business, the allocation of more shipping orders to one agent to service increased business necessitates fewer orders to other agents and results in a corresponding loss of business.

In general, shipping orders, boxcars, and delivery quotas tend to be equalized among elevators, resulting in a situation in which no individual elevator can sustain a significant increase in throughput. In addition, lower than cost handling rates and higher than cost storage rates are incentives for elevator companies to emphasize grain storage rather than increased handling. Railways are generally reluctant, under Crow's Nest freight rates, to replace existing rolling stock with new technology, such as unit trains. The entire grain handling-storage-transportation complex is locked into a low level of economic performance. A maze of legislation and regulations nullifies effective competition, and no

firm is able to improve significantly, its level of operational efficiency.

The basic operational problem in commercial grain market channels is surplus capacity--too many elevators and too much trackage relative to the volume of business. Efficiency may be improved by substantially increasing aggregate grain sales and/or reducing the amount of redundant overhead. Both actions require integrated cooperation and planning and a greater measure of effective competition. These changes, together with improvement in exchange efficiency, may be expected to increase the level of grain marketing efficiency.

Other Problems Related to Traditional Quota Policy

This section completes the list of production and marketing problems associated with the operation of traditional CWB quota policy [Boden, 1970; MacFarlane, 1969; McLeod, 1969]. Most of the following problems are administrative and technical in nature, problems the Assignable Acreage Quota System would try to overcome.

Unit quota--It was not specific as to type or quality of grain delivered; hence, grain not currently in demand was often delivered contributing to elevator congestion. Timing of unit deliveries could not be predicted with accuracy because producers often delayed until the unit could be used to clean out a bin. The unit quota equalized income from delivery, benefiting small producers the most through an internal income transfer. Only the very smallest farmers benefited from the early fall provision of cash to cover operating expenses, a benefit

superseded by the Prairie Grain Advance Payments Program.

Specified acreage or general quota--It was not specific either to type, quality, or timing of delivery. There was a tendency for producers to deliver the highest grades of wheat before other alternatives because of greater returns, thereby contributing to elevator congestion with high grades. However, the quota permitted delivery of grain carried over from previous crop years without having to seed crops in oversupply.

Seeded acreage quotas--These were specific as to type of grain but not quality or timing. Whenever farm carry-over occurred, there was a tendency for farmers to retain a quota base the following year by seeding crops for which demand had fallen.

Over quota privileges--These permitted delivery of selected types and qualities of grain for specific purposes, such as malting barley. Because most producers believed they would be successful in having a carlot of malting barley selected for over quota shipment, about 80 percent of all barley seeded was of malting type (low protein), the balance being higher yielding, high protein feed varieties [Barnsley, 1970]. In contrast, about 90 percent of barley production was used for livestock feed (where high protein is important) and 10 percent for malt; the probability of any individual producer having a carlot of barley accepted for malting was about one in twenty (10,000 cars among 200,000 producers).

Quota maximization and equalization--Pressure on the CWB to maximize and equalize quotas by the end of the crop year created on occasion intolerable elevator congestion.

Cumulative quotas--Quota levels that increased cumulatively throughout the crop year made it difficult to predict deliveries accurately and created a large unused quota base as incentive for illegitimate deliveries.

Restriction of deliveries to a single point--Prior to introduction of the Producers' Account Identification System and the Block Shipping System, this regulation was apparently necessary for administrative reasons. It tended to inhibit, however, any trend towards elevator and transportation rationalization.

Income Levels, Stability, and Distribution

The level of gross income is a product of total sales and grain prices; the level of net income is gross income minus total costs per unit of time. Income stability refers to the degree of constancy in levels of income within and across time periods. Income distribution refers to the manner in which aggregate income is allocated among producers.

Relationships Between Quota Policy and Income Levels

Whenever quota policy fails to match grain flow with customers' requirements--quantity, quality, position, and timing--it contributes to customer dissatisfaction, lost sales, and lower income. Higher average prices and higher

incomes accrue to producers when quota policy diminishes an accentuated seasonal price pattern; lower incomes accrue to marketing firms (recall Cases 2 and 5, Chapter II). When aggregate supply is restricted by quotas to raise prices, price elasticity determines whether the implied reduction in sales is accompanied by lower or higher income (recall Cases 4, 5, and 6, Chapter II). Producers' net incomes are lower than their potential because quota policy contributes to increased production and marketing costs. Quota policy alone cannot generate higher income levels; aggressive marketing and efficient production policies are more important in this respect.

Relationships Between Quota Policy and Income Stability

When quota policy diminishes an accentuated seasonal price pattern, it stabilizes income within a crop year. As a supply control device, it tends to stabilize incomes over time. In these respects quota policy is only one tool, to be used with inventory, merchandizing, and supply management policies.

Relationships Between Quota Policy and Income Distribution

The distribution pattern of income among farmers arising from quota policy is one of the policy's most significant impacts. In an open market situation approaching perfect competition Pareto efficient combination of resources in production and marketing activities ensures an equitable distribution of income in relation to the marginal value product of resources. In the name of equity,

quota policy emphasizes a more equal distribution of demand, hence income, among producers. But greater income equality is not necessarily more equitable if the production and marketing of grain become less efficient (marginal product/factor price ratios not equal for all inputs).

Assessed against the background of Pareto optimum income distribution, the following internal income transfers arising from quota policy are observed 1) from efficient to inefficient producers; 2) from low to high cost producers; 3) from large to small producers; 4) from producers located close to elevators to those further away; 5) from specialized grain growers to farmers diversified in grain and livestock; 6) from farmers on high productivity land to farmers on marginal land; 7) from land intensive to land extensive farmers; 8) from producers who would market later in the crop year to those who would market earlier; 9) from early technology adopters to later ones. In general, the income transfer is from low cost, efficient, large farms to high cost, less efficient, small farms. The net effect of quota induced income distribution is retardation of the out-migration process from grain production and underemployment of resources.

Analysis of CWB permit book data [CWB, SRFA, 1969-70] reveals that 106,831 farmers, or 56.5 percent of all permit book holders, operated less than 400 specified acres and in aggregate operated 23.2 million specified acres, or 27.4 percent of the total. Calculation reveals that even under ideal conditions these farmers, if they concentrated on commercial wheat production and sold total output on quota at quota prices, could earn a return to labour and management

of only about $1,000 per year. Therefore, even under the most favorable quota redistribution of demand--selling total output of wheat on-quota--and income from commercial grain sales, approximately 100 thousand existing farmers do not possess sufficient resources to earn an adequate income solely from commercial grain production.

It is concluded that the use of quota policy for income redistribution is probably not a very effective social policy for dealing with 'the small farm problem'. If quota policy is used at all, it should be a tool of marketing policy. Other tools should be devised for facilitating the farm adjustment process--programs for farmer retirement, retraining, and relocation; farm diversification, consolidation, and abandonment; and local industry creation.

CHAPTER VI

ANALYSIS OF QUOTA POLICY OBJECTIVES AND SPECIFICATION OF ALTERNATIVES

This chapter focuses first on the determination of a set of quota policy objectives. The approach followed is to list potential objectives, analyze their interrelationships through deductive reasoning, specify what the objectives ought to be in the context of economic theory, examine literature sources for indications of consensus in the grain industry and then to designate a set of objectives for further consideration in Chapter VII. Three program alternatives are specified in the second part of the present chapter.

Analysis of Objectives

The determination of a set of objectives agreeable to a majority of the participants in the grain industry is prerequisite to the delineation of a demand allocation program. In this respect, a successful policy decision--a decision that a certain program is to be implemented to achieve a specific set of objectives--necessitates a correspondence between stated objectives and actual impacts.

Potential Objectives

Table 3 lists sixteen potential aggregate objectives for quota policy

Table 3

INTERRELATIONSHIPS AMONG POTENTIAL QUOTA POLICY OBJECTIVES

	Potential Objectives															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	-															
2	-															
3	+			-	-		-									
4	+															
5	+															
6	+															
7	+															
8	-	+				-	-									
9	-	+		-		-	-									
10	-		+	-	-		-				-	-		-	-	-
11	+	-	-	+	+			-	-	-						
12	+	+	+		+			+	+	+	-			+	-	-
13	+	+		-		+	-	+			-			+	-	-
14	+	+	+	-	+	+	-	+	+	+	-	+	+		-	-
15																+
16	+			+	+						+					

1 Higher net income
2 Income stability
3 Income equality
4 Production efficiency
5 Marketing efficiency
6 Higher prices
7 Higher sales
8 Price stability
9 Delivery stability
10 Equal demand allocation
11 Equitable demand allocation
12 Orderly marketing
13 Supply control
14 Supply management
15 Simplicity
16 Flexibility

and portrays their positive, negative, and neutral interrelationships (analogous to a means-end continuum) as determined by consideration of theory and reality. The table is understood by reading across rows and asking the following typical questions: 1) Does the pursuit of objective 1 contribute to the attainment of objective 2? If affirmative, a plus entry is observed. If negative, ask: 2) Does the pursuit of objective 1 conflict with the attainment of objective 2? If affirmative, a negative entry is observed. If negative, then no entry is observed.

For example, consider the objective of 'equitable demand allocation:'[1] It is observed that the pursuit of this objective contributes to the attainment of a higher net income, and production and marketing efficiency but conflicts with income stability and equality, price and delivery stability, and equal demand allocation; and is neutral in relation to higher sales and prices, orderly marketing, supply control, simplicity, and flexibility. Consider also pursuit of the objective 'equal demand allocation.' It contributes to income equality, is neutral in relation to income stability, higher prices, price and delivery stability, and supply control, but conflicts with all other objectives.

When a subset of objectives is specified for a program, the interrelationships often become very complex. In general, not all objectives in a subset can

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[1]It may be recalled that equitable is defined in the present study as that quality of fairness and justness accruing to producers when income distribution reflects an approximation of Pareto efficient resource combination; thus equitable and equal are not necessarily equivalent. (Refer to footnote, page 1).

be pursued with equal vigor. It becomes important to establish a preference ordering for the objectives. For example the simultaneous attainment of higher production efficiency and more equal demand allocation is virtually impossible; the former increases net income and lowers production costs, the latter lowers net income and raises production costs. Some 'trade-off' or compromise becomes necessary in this instance.

Economic Objectives

On the basis of economic theory four objectives are suggested as desirable: 1) higher net income; 2) orderly marketing; 3) higher production efficiency; 4) higher marketing efficiency. They are complementary objectives, and their pursuit has a high probability of achieving Pareto optimum resource and product allocation in the grain industry. There is no justification in economic theory for the use of quota policy techniques for achieving these objectives. The use of a quota system to achieve any other objectives can be expected to result in a significant departure from Pareto efficiency.

Consideration of Industry Consensus

The Boden Committee on Quota Policy [1970, p. 4] accepted as primary objectives: 1) orderly marketing, and 2) supply control. As secondary objectives the committee members accepted: 1) equitable (equal) market access, 2) limited freedom of elevator choice, 3) marketing efficiency, and 4) administrative

simplicity. A number of principles were listed which amount to third order objectives. These are; 1) production efficiency, 2) resource mobility, and 3) deliveries related to productivity. The committee emphasized the importance of the primary objectives and stated that second and third order objectives should be aimed at only if they did not conflict with first order objectives. These objectives are certainly much more comprehensive than in the past in that they shift emphasis away from the original objective of equitable (equal) allocation of limited elevator space.

The Federal Task Force on Agriculture recommended that the objective for quota policy should be: 1) orderly marketing, and 2) equitable (equal) treatment of farmers unable to deliver grain during any part of the crop year [MacFarlane, 1969, p. 132]. At the Second Canadian Agricultural Congress, three different sets of objectives were accepted by three discussion groups. Group 1 revised the Task Force objectives to read: 1) orderly marketing, and 2) equitable (equal) treatment of farmers in delivery opportunity. Group 2 accepted the Task Force objectives. Group 3 supported the Boden Committee recommendations [CDA, 1970b, p. 11].

If a consensus exists, it is that orderly marketing, equitable delivery opportunity (equal demand allocation), and supply control ought to be objectives of quota policy. Income and efficiency objectives appear to rank lower in priority.

Designation of Objectives

For the purposes of the present study, the following objectives (unranked) are designated for further consideration in Chapter VII. 1) Orderly marketing--the matching of grain flow with demand specifications; 2) More equal demand allocation--the distribution of deliveries, market channels, and income in proportion to some fixed resource; 3) Equitable income distribution--the state of justness in income distribution associated with a Pareto optimum distribution of demand and market channels; 4) Supply control--the limitation of production to raise price; 5) Production efficiency--least-cost production; 6) Marketing efficiency--least-cost marketing; 7) Simplicity--the quality of being relatively easy to understand and administer; 8) Flexibility--the capacity for facilitating technological change.

Alternative 1: The Open Market

The open market alternative envisages a system being a more perfect implementation of the model of perfect competition than previously experienced by the grain industry. Instead of using a delivery quota mechanism, the price mechanism would be the means by which the commercial market would be allocated among producers and the available supply allocated among buyers. The system could be operative for any or all prairie grains. The futures market would be more highly refined and its operation supervised by a federal regulatory

body. Provision for farmers to deliver against a short hedge at interior points would be established. A vastly improved supply, demand, and price information system would be developed to approach as closely as possible a situation of perfect market knowledge among all producers, the private grain trade, and governments.

Institutional restrictions on the flow of grain would be eliminated. This means that the CWB monopoly over wheat, oats, and barley might be lifted, all restrictions on interprovincial movement of grain removed, Feed Freight Assistance ceased, and the tariff on U. S. corn withdrawn. The CWB might continue as a voluntary marketing board in competition with private grain merchandizing firms and other voluntary selling agencies that producers might wish to establish independently or through pool elevator companies.

A minimum floor price program could be established by the federal government to introduce limited price stability over time. Such support prices would be linked to U. S. support prices to enable price competitiveness, even if the market price dropped to the floor on occasion. The support price could be made operative via deficiency payments or a government (CWB) purchase and resale program. A short-term operating loan program for all grains could be established to enable producers to hold grain on the farm until prices became sufficiently attractive to sell. Such a seasonal price stabilization program would prevent excessive depression of prices in fall months as a result of supply-demand imbalance.

Alternative 2:

Assignable Acreage Quotas

All existing institutions and programs, except the existing quota system, would remain intact. Separate delivery quotas would be established for each major grain and each class of grain for which there is a clearly defined commercial use. Assignable acreage would be defined as total cultivated acreage, and a producer could assign any number of acres to any crop in order to arrive at quota acres. Seeded acreage would not have to equal quota acreage. Deliveries would be called for at each quota level on the basis of the total quota acres for each grain. Deliveries on occasion might be specified by grade, and advance quotas might be used to enable the matching of grain flow to particular market requirements.

Each quota level would have a flexible expiry date after which time a producer would lose delivery opportunity at that level. Quota levels would be established by shipping block in accordance with estimated available supplies therein. Quota levels would vary among shipping blocks throughout the crop year, but an attempt would be made to equalize levels in all shipping blocks by the end of the crop year. Producers would be permitted to deliver to an alternate elevator point. Delivery opportunities would be suspended for illegal deliveries.

The system would be supplemented by a more extensive market information system. An attempt would be made to forecast sales for the forthcoming crop year.

Estimates would be made of the number of acres farmers in aggregate might assign to each crop. This information would then be converted to an expected delivery rate per quota acre and together with information on prices would be communicated to producers prior of seeding.

Alternative 3: Negotiable Marketing Certificates[1]

All existing institutions and programs except the quota system would remain intact. The certificate system would be operated by a commodity agency, such as the CWB. An aggregate certificate base for each grain would be calculated in terms of the average deliveries of all producers into commercial channels over some recent historical period. At the same time individual bases would be established for all producers in terms of the average deliveries of each grain over the same period. Alternatively, individual bases could be adjusted by an index of yield productivity, or they could be auctioned to producers.

Once bases were established, then marketing certificates would be issued to producers in the amount of the base. A marketing certificate would be defined as a legal document entitling the registered owner (the producer) to deliver each crop year into commercial channels a quantity of grain specified in proportion

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[1]The term 'marketing certificate' appears to have first been used by Cochrane [1959]. In substance the term is equivalent to the terms 'marketing quota' or 'marketing base'.

to the quantity of grain stated on the face of the certificate. Each producer would own marketing certificates for each grain for which he had been allocated a certificate base. Alternatively, the agency could retain ownership of the certificates and grant them to producers for use in perpetuity, subject to recall.

Certificates would be fully negotiable subject to a set of rules established by the commodity agency. For example, only bona fide producers could buy and sell certificates. All transactions would be registered with the agency, and current trading prices would periodically be published. The agency could recall a percentage of each transaction and use this certificate reserve to grant free of charge to new producers. The agency could also buy and sell certificates either to influence certificate prices or to influence certificate redistribution patterns.

Delivery of grain would occur in an orderly fashion in relation to marketing certificates. Only certificate owners would be eligible to deliver. Delivery levels would be established as a proportion of the aggregate certificate base. For example, 10 percent, 20 percent, . . . 120 percent, etc., delivery levels would be specified. The option to specify deliveries on certificate by grade would exist, as would the opportunity to equalize delivery levels among certificate holders. As with any other quota system, an effective market information system would be implied.

CHAPTER VII

ANALYSIS OF ALTERNATIVES

Drawing upon material discussed earlier, the present chapter focuses on three alternative programs in terms of their ability to achieve various objectives. Of many possible program variations, these three--the open market, assignable acreage quotas, and negotiable marketing certificates--were chosen because they represent mutually exclusive conceptual approaches.

The open market is an approach characterized by the absence of institutional influences on demand allocation; the assignable acreage quota system by the institutional allocation of demand in proportion to a single production input (e.g., land); and the negotiable marketing certificate system by the institutional allocation of demand in proportion to an output quota, apart from other inputs. The analytical procedure is divided into two parts: 1) *a priori* analysis of the general impacts of each alternative; and 2) empirical analysis of the specific impacts on a typical prairie grain farm. Deductive reasoning is employed in the first part of the analysis and linear programming in the second.

In a policy making setting, a subset of objectives reflecting economic considerations and the needs and wants of grain industry participants would be specified. The choice of a program alternative would be based on a

probability estimate of the potential of each program for achieving the specified objective set. Normally the program evidencing the highest probability for objective attainment would be selected for implementation.

A Priori Analysis

Alternative 1: The Open Market

The open market alternative (as described in Chapter VI) more closely approximates the model of perfect competition than any previous structure utilized by the western grain industry. It tends towards S. H. Sosnick's concept of 'effective competition' [Sosnick, 1968, p. 82]. By implication, its implementation would represent a dramatic departure from the legislative and institutional trends of the past thirty-five years. This alternative assumes that the price mechanism would integrate adequately many thousands of independent decisions leading to Pareto optimum allocation of resources and products.

The attainment of orderly marketing under the open market is feasible provided: 1) there are few factors inhibiting the flow of product in response to price; 2) there is adequate communication of demand-supply-price situations to all market participants; 3) there are sufficient facilities permitting farmers to store grain until demand and price encourages delivery; and 4) farmers have access to adequate short-term operating capital to prevent forced sales. Although still possible, accentuated seasonal price patterns

(Cases 1 and 4, Chapter II) arising from short run demand-supply imbalances would be minimized.

Economic theory predicts that the attainment of production and marketing efficiency ought to be possible via the open market. Only least-cost forms of production and marketing could withstand the rigors of competition, with high cost operations shifting resources to alternative uses or going out of business. As resources were utilized more efficiently, the grain industry would tend towards Pareto optimum organization; the effect would be equitable income distribution in relation to the marginal products and prices of inputs.

In addition, the operation of the open market would be relatively easy to understand by all participants, but the need for a minimum of legislative and institutional interference might not be so readily comprehended. The open market would be flexible. Changes in production-marketing processes in response to price changes and the development of new technology would occur fairly rapidly; changes in market structure could occur if the need arose.

On the other hand, greater equalization of demand and income among producers would not necessarily be a characteristic of open market operation because of the great variation in resource productivity within the industry. Supply control--the limitation of production to raise price--could be attainable indirectly through simultaneous response of producers to common market signals. The vagaries of export demand would probably contribute to significant price fluctuations, although they would tend to be minimized by producer response

to accurate future market information. The market generally would be cleared each year with prices and incomes being the highest possible given the prevailing demand-supply situation.

Subsidiary effects of the open market would be: 1) a tendency towards interregional specialization of production according to comparative advantage, soil-climatic capability, and producer preference; 2) just compensation for higher productivity; 3) land values more closely reflecting the stream of economic rent accruing as a function of the productivity of particular farm units; 4) more rapid rationalization of grain handling and transportation operations; and 5) acceleration of farmer migration out of grain farming.

Alternative 2: Assignable Acreage Quotas

The assignable acreage quota system would be consistent with legislative trends in many phases of the agricultural industry. Centralized administrative decision-making would replace the price mechanism as a means of allocating demand, market channels, and income. Implementation of this system would imply the ability of a central authority to make on average more correct decisions influencing grain production and marketing than many thousands of individuals and firms acting independently.

Orderly marketing and the minimization of accentuated seasonal price patterns would seem attainable. However, conflicts with the pursuit of other objectives (e.g., equality of demand allocation) and miscalculations

of customers' needs might occasionally contribute to market channel congestion. Supply control would be possible as long as the system were accompanied by a market intelligence program providing future information at least as reliable as that provided by a futures market (which by implication would either not exist or not be effective if it did exist).

The system would be neither particularly simple to operate nor easy to understand. Even with guaranteed minimum delivery levels, it would likely be difficult for farmers to assign their acres with confidence without knowing how other farmers intended to assign or what the total quota base for each grain was to be. Although the system would be flexible in the sense of being changeable if it did not work or if objectives changed, it would not be very flexible in permitting entrepreneurship or producer adoption of new technology.

Although more equal demand, market channel, and income allocation would be possible under assignable acreage quotas, equitable distribution would not necessarily occur (because marginal product/price ratios and Pareto efficient resource combination are not necessarily implied). Pursuit of greater income equality would conflict with production and marketing efficiency by contributing to an overuse of land extensive inputs (as under the traditional specified acreage quota system, there would be a premium on land to enlarge the quota base, especially when quota levels were restrictive).

Though production and marketing efficiency generally would be difficult to attain under Alternative 2, two actions for offsetting these problems are possible: 1) grain sales increase sufficiently so that quota levels are not restrictive (i.e., quota rates greater than potential yields), and/or 2) quota levels are not equalized. The first action would relegate the role of Alternative 2 to that of orderly marketing (as described by Case 2 or 3, Chapter II). If the second action were to occur, it could imply a decision by the central authority to allocate delivery opportunities to those areas (e.g., shipping blocks) with supplies coincident with demand specifications. Or it could also imply demand allocation to those areas indicating higher levels of production efficiency. The former implication would necessitate information on supply characteristics, and the latter, information on costs of production. The current existence of supply information and the lack of appropriate cost information (detailed by shipping block) suggest the former action to be more plausible than the latter in the short run.

Apart from the aforementioned variations, the subsidiary effects of Alternative 2 would appear to be: 1) induced diversification of production and marketing activities, regardless of comparative advantage, resource capability, or producer preference; 2) slowing of productivity growth rates because resources are combined inefficiently; 3) equalization of land values across the prairies, bearing limited relation to physical productivity; 4) slowing of market channel rationalization; and 5) retardation of the farmer out-migration process.

Alternative 3: Negotiable Marketing Certificates

A system of negotiable marketing certificates (or quotas) for one or more grains would be consistent with prevailing legislative trends yet would be a significant departure from the concept of relating delivery opportunities to a single resource input. Although centralized decisions would allocate demand in relation to an aggregate quantity base, certificates representing shares of the aggregate base would be allocated, after initial distribution, among producers via the price mechanism. In many respects such a system would tend to reduce the conflicts among orderly marketing, supply control, equity, and production and marketing efficiency. One proponent of a system of negotiable marketing certificates for controlled commodities claims that 'it achieves the impossible; it permits production flexibility at the local level within a controlled aggregate' [Cochrane, 1959, p. 702].

Orderly marketing and minimization of an accentuated seasonal price pattern would be attainable as supply flow was matched with demand through sequentially increasing delivery levels. Aggregate supply control also would be possible provided it were accompanied by a market intelligence system as effective as that required for assignable acreage quotas.

Although initial distribution of certificates would reflect existing resource misallocation, the attainment of a higher level of production efficiency would be possible because certificates could be purchased as production inputs

and combined with other resources in least-cost ratios. Suppose one axis of an isoquant-isocost diagram represents certificates, the other, the bundle of other factor inputs, then if the delivery rate permitted a smaller quantity of sales than that represented by isoquant q_2, additional certificates could be purchased to bring sales back to the q_2 level. As the prices of certificates and other inputs changed in a dynamic context, the slopes of the isocost curves would change, but because of certificate negotiability firms would be able to adjust input ratios to approach Pareto efficient production.

In addition, as certificates were transferred among producers, interregional production patterns would tend to shift to reflect comparative advantage, agronomic capability, and producer preference. Negotiable certificates would tend also to enhance resource productivity provided a limit or tax were imposed on the certificate owner after a farm had expanded to the size of an 'economic unit.' The sale of certificates by some farmers with higher marginal costs would yield a lump sum of money for investing in a livestock operation (or other alternatives) or for retiring on the farm. An implicit impact would be advancement of the out-migration process at an uninhibited rate.

Marketing efficiency would tend to be enhanced because of the possibility for interregional specialization of production and use of market channels (i.e., as some areas specialized, fewer marketing facilities for commercial grain would be required in others). However, the existence of other institutional constraints on the use of market channels and the pursuit of

an objective of more equal delivery opportunities among certificate owners would tend to retard the attainment of higher levels of marketing efficiency.

More equitable demand and income distribution (in the Pareto efficient sense) would be implicit in the attainment of greater production and marketing efficiency. While more equal demand and income allocation among certificate holders would be feasible, the negative effect on efficiency would not be as great as if equalization occurred among all producers.

Negotiable marketing certificates would be more complex to administer than assignable acreage quotas because of the need for a mechanism to monitor certificate transactions. The concept of certificate transferability apart from land might not be easily understood. And though the system would enhance flexibility of resource allocation in response to price and other market changes, it might be difficult to dismantle once certificates had taken on a value and begun to shift among farmers.

Certificate transaction prices would generally reflect certificate demand-supply forces and the degree of constraint imposed by the delivery rate. Their minimum value would be zero given no restrictions on aggregate grain deliveries. (If such a situation prevailed in the long run, there would be little utility gained from the existence of a certificate system.) Their maximum value would tend to reflect the capitalized gain in income expected as farmers shifted from sale in lower priced product, noncertificate markets to higher priced product, certificate controlled markets. As certificates increased

in value, land values would tend to fall by a corresponding amount to a level reflecting the capitalized income stream from lower economic uses--feed barley, oats, or hay production (assuming certificates existed only for 'premium' crops, such as bread wheat, durum wheat, or malting barley).

As long as land prices fell correspondingly, there would not necessarily be any increase in the opportunity costs of production. However, if they did not fall, then opportunity costs would rise, and the rate of return on total farm investment would decline.

Empirical Analysis

Purpose

The purpose of this section is to analyze the impact of three quota program alternatives on the profit maximizing performance of a typical prairie grain farm.

Methodology

The procedure consists of the following steps:

1) Determination of the cost structure of a typical farm for the various grains it is capable of producing.

2) Specification of a set of commodity prices at farm level.

3) Determination of a common aggregate delivery situation.

4) Construction of linear programming models reflecting the constraints imposed by three quota programs.

5) Maximization of returns to land in each model utilizing a linear programming algorithm.

6) Analysis of the organization of production-marketing activities and commodity output levels from the primal solution and analysis of the constraint shadow prices and sensitivity limits from the dual solution.

7) Interpretation of the results.

Data

Farm cost data--The source is Saskatchewan Farm Business Summaries [SDA, 1965 through 1969]. The farm cost structure derived is typical of a 960 acre grain farm located in central Saskatchewan on Dark Brown Soil. The total cost figures consist of four components: 1) cash operating costs; 2) depreciation; 3) non-land investment; 4) labour and management. Land costs are excluded because the objective function is the maximization of returns to land. The relevant cost data appear in Table 4.

Implicit in the cost data is a five year average seeded/summerfallow ratio of 63:37, or slightly less than two-thirds of total cultivated acres seeded to grain crops and the balance summerfallow. The cost of summerfallowing is included in the cost per cultivated acre. It is assumed that no forage or miscellaneous crops are produced and that all seeded land is sown to one of the six major grains: wheat, barley, oats, rye, flax, or rapeseed. It is assumed that the cost per cultivated acre of growing any of these grains is the same; thus any difference in cost per bushel is a function of yields. The return to

non-land investment is calculated at 6 percent interest, and the average return to labour and management is $4,600 per year.

Table 4

NON-LAND COSTS - 960 ACRE GRAIN FARM
DARK BROWN SOIL ZONE, SASKATCHEWAN
(1965 through 1969)

Cost Item	1965	1966	1967	1968	1969	5-Year Average
	-$ per cultivated acre					
Cash Operating	6.88	6.22	7.86	7.71	6.72	7.08
Depreciation	2.42	2.54	2.78	2.96	3.03	2.74
Non-land Investment	1.06	1.04	1.48	1.63	1.92	1.43
Labour and Management	4.41	4.48	4.86	4.97	5.18	4.78
Total Non-land Costs	14.77	14.28	16.98	17.27	16.85	16.03

Source: Saskatchewan Department of Agriculture, Saskatchewan Farm Business Summaries (Regina: SDA, 1965-69). [It is assumed that cultivated acres equal grain acres. The actual average grain acreage is 992 acres but when rounded off to 960 acres falls within the relevant range of 900-1199 cultivated acres.]

Crop yield data--Yields for the six grains are derived from yield data contained in the Saskatchewan Farm Business Summaries for the same farm size, soil zone, and years. Yields per seeded acre reflect a summerfallow crop/ stubble crop ratio of 59:41. Table 5 contains the relevant yield data for the six grains. Durum wheat is assumed to be the same as other hard spring wheat, and malting barley is assumed to yield the same as feed barley.

Table 5

GRAIN YIELDS - 960 ACRE GRAIN FARM
DARK BROWN SOIL ZONE, SASKATCHEWAN
(1965 through 1969)

Grain	1965	1966	1967	1968	1969	5-Year Average
	-bushels per seeded acre-					
Wheat	22.9	27.8	22.0	20.4	26.8	24.0
Barley	38.2	32.1	23.3	25.0	42.7	32.3
Oats	40.6	42.1	40.2	33.5	42.3	39.7
Rye	10.0	18.8	14.5	20.3	19.3	16.6
Flax	14.8	15.0	11.8	13.0	14.7	13.9
Rapeseed	8.6	17.2	16.7	10.8	7.1	12.1

Source: Saskatchewan Department of Agriculture, Saskatchewan Farm Business Summaries (Regina: SDA, 1965-69).

Because the cost data is per cultivated acre, it is necessary to convert average seeded acreage yields to average cultivated acreage yields. This is done by multiplying the seeded acreage yield by a factor of 0.63, or the proportion of cultivated acreage seeded to any grain crop. (Another way of doing the calculation is to convert the cost per cultivated acre to a seeded acreage basis). The five year average yield per cultivated acre for each grain is portrayed in Table 6. The cost per bushel of each grain is calculated by dividing the average non-land cost of $16.03 per cultivated acre by the relevant average yield per cultivated acre. Table 6 also illustrates average per bushel costs for each grain.

Table 6

GRAIN YIELDS AND COSTS - 960 ACRE GRAIN FARM
DARK BROWN SOIL ZONE, SASKATCHEWAN
(1965-69 Average)

Grain	Average Yield	Average Cost
	-bushels per cultivated acre-	-$ per bushel-
Wheat	15.2	1.06
Barley	20.4	.79
Oats	25.1	.64
Rye	10.5	1.53
Flax	8.8	1.82
Rapeseed	7.6	2.11

Source: Derived from Tables 4 and 5.

Price data--The farm cash price for commercial grain is the final average annual cash price, basis in store, Thunder Bay, for crop year 1967-68, minus appropriate transportation and handling charges to central Saskatchewan. The farm cash price for noncommercial grain is the initial payment, basis in store, Thunder Bay, less handling and transportation. Table 7 illustrates the grade specification for each grain, Thunder Bay prices, transportation and handling charges, and farm cash prices.

Delivery data--Aggregate deliveries are based on the expected sales situation for 1971-72. Assignable acreage delivery rates are derived from information announced by the federal government [Lang, 1971]. It is assumed that deliveries under Alternatives 1 and 3 are not sufficiently great to influence product prices. The delivery rates for Alternative 2 are: Spring Wheat - 9; Durum Wheat - 9; Malting Barley - 1 car; Feed Barley - 20; Oats - 15; Rye - 20; Flax - 15; Rapeseed - 20. A rate of 9 for wheat, for example, means that a farmer may deliver 9 bushels for each acre assigned to wheat. One carlot of malting barley may be shipped, if accepted and 50 acres are assigned. Assignable acreage is assumed to be equal to cultivated acreage. By comparing yields per cultivated acre (Table 6) with assignable acreage delivery rates, it is noted that the latter are restrictive for spring wheat, durum wheat, malting barley, feed barley, and oats, but are not restrictive for rye, flax, and rapeseed. Such a constraint pattern is typical of that prevailing under the specified acreage quota system for many years.

Table 7

FARM CASH PRICES - 960 ACRE GRAIN FARM
DARK BROWN SOIL ZONE, SASKATCHEWAN
(1967-68 Average)

Grain	Grade	Thunder Bay	Transportation And Handling	Farm Cash Price
Commercial Prices:			-$ per bushel	
Spring Wheat	3 Northern	1.76	.17	1.59
Durum Wheat	2 CWAD	1.90	.17	1.73
Malting Barley	2 CW 6 Row	1.12	.15	.97
Feed Barley	1 Feed	1.01	.15	.86
Oats	1 Feed	.78	.12	.66
Rye	3 CW	1.22	.16	1.06
Flax	2 CW	2.72	.17	2.55
Rapeseed	1 CW	2.10	.16	1.94
Noncommercial Prices:				
Wheat	1 Feed	1.33	.17	1.16
Barley	1 Feed	.97	.15	.82
Oats	1 Feed	.60	.12	.48
Rye	Feed	1.04	.16	.88

Source: Canada Dominion Bureau of Statistics, Grain Trade of Canada, 1967-68, Cat. No. 22-221 (Ottawa: Queen's Printer.)

Net return data--Net per bushel return to land for each grain is calculated as the farm cash price minus the calculated per bushel non-land costs. The net return per bushel to land for each production-marketing activity is a coefficient in the objective function. It is noted here that the empirical results cannot be relied upon for production planning in 1971-72 because the cost structure and market prices will be different from those used in this analysis. The results can be expected, however, to yield information about the relative impacts of quota policy.

Maximizing Procedure

It is assumed that total production is sold and carry-over either remains constant at some level or is nil. Constant returns to scale and mutual independence of production-marketing activities are assumed. The general linear programming problem is:

Maximize: $Z = CX$ (Objective Function)

Subject to: $AX \leq b$

$X \geq 0$ (Constraints)

where: Z = Total residual return to land, quota or certificate;

C = Coefficients of the Objective Function;

X = Production-marketing activity levels;

A = Matrix of input-output coefficients;

b = Production-marketing constraints

The linear programming matrices for the three quota program alternatives are contained in Appendix B. Alternatives 1 and 2 have twelve production-marketing activities. The results for Alternative 2 are converted to quantity restrictions for the six activities greater than zero and the linear program rerun with six activities to calculate the marginal value of marketing certificates. The activity levels of the second alternative are built into Alternative 3 as existing quantity constraints, and provision is made to purchase additional marketing certificates for four grains. Alternative 3 has eleven activities. Each alternative has cultivated acres constrained at 960 acres. No constraints are imposed for capital, labour, or management. Each alternative has a production constraint of 160 acres each for durum wheat and flax. Alternative 1 has a production constraint for rapeseed. Limited market opportunities and the problems of disease necessitate voluntary production restraint for these three latter activities.

A marketing constraint of one car or 2000 bushels of malting barley is imposed in Alternatives 2 and 3, as well as a sales constraint in the non-quota market at 1000 bushels for feed wheat and 4500 bushels for feed barley. Again, the limited nature of the market is the reason for such constraints. In Alternative 2 assignable acreage is constrained at 960 acres. In Alternative 3 there are no restrictions on the amount of spring wheat, durum wheat, malting barley, or flax that can be sold on purchased marketing certificates. Total grain sales, total revenue, and total costs are calculated as accounting activities

in all three programs. The price at which negotiable marketing certificates can be bought or sold in Alternative 3 is arbitrarily set at one-half the marginal value of certificates as calculated in the Alternative 2 rerun. This price is reflected in a reduced per bushel return to land. All unused certificates are sold. Analysis of fixed asset valuation is performed using a net income capitalization procedure.

Results of Analysis

Pertinent results of the analysis are summarized in Table 8. Under Alternative 1 net return to land is maximized at \$7,595, compared with \$6,122 and \$6,608 for Alternatives 2 and 3 respectively. In each alternative total supply of 960 cultivated acres is utilized, 355 acres of which are summerfallow and 605 acres of which are seeded to various grains. Under Alternative 1 a total of 14,520 bushels of grain is produced and sold, resulting in a gross income of \$22,984 and total non-land costs of \$15,389. Alternative 2 produces 13,888 bushels of grain yielding \$21,511 in gross income for the same cost of \$15,389. Alternative 3 produces 12,904 bushels for a total sales value of \$22,780 and total costs of \$16,172.

Two crops are produced under Alternative 1, 445 acres of spring wheat yielding 10,680 bushels and 160 acres of durum wheat yielding 3,840 bushels, all of which is sold in the commercial market. In contrast, five crops are produced under Alternative 2. Wheat is seeded on 167 acres

Table 8

SUMMARY OF LINEAR PROGRAMMING OF RESULTS AT OPTIMUM NET INCOME LEVELS

Item	Units	Program Alternative		
		1	2	3
Land Use:				
Cultivated Land	Acres	960	960 (960)[1]	960
Summerfallow	"	355	355	355
Grain Crops	"	605	605	605
Spring Wheat	"	455	125 (335)	285
Feed Wheat	"	-	42	-
Durum Wheat	"	160	160 (427)	160
Malting Barley	"	-	62 (50)	-
Feed Barley	"	-	56	-
Feed Oats	"	-	-	-
Rye	"	-	-	-
Flax	"	-	160 (148)	160
Rapeseed	"	-	-	-
Sales:				
Total Sales	Bushels	14520	13888	12904
Commercial:				
Spring Wheat	"	10680	3015	6840
Durum Wheat	"	3840	3840	3840
Malting Barley	"	-	2000	-
Feed Barley	"	-	-	-
Feed Oats	"	-	-	-
Rye	"	-	-	-
Flax	"	-	2224	2224
Rapeseed	"	-	-	-

[1]Assignable acres allocated to crops for commercial delivery on quota acres.

Table 8

SUMMARY OF LINEAR PROGRAMMING OF RESULTS
AT OPTIMUM NET INCOME LEVELS
(continued)

Item	Units	Program Alternative		
		1	2	3
Sales: (continued)				
Noncommercial:				
Feed Wheat	bushels	-	1000	-
Feed Barley	"	-	1809	-
Feed Oats	"	-	-	-
Feed Rye	"	-	-	-
Income:				
Total Revenue	Dollars	22984	21511	22780
Total Cost	"	15389	15389	16172
Net Return to Land	"	7595	6122	6608

[1] Assignable acres allocated to crops for commercial delivery on quota acres.

producing 4,015 bushels, 3,015 bushels of which is marketed on quota and 1,000 bushels off quota as feed. As in Alternative 1, durum wheat accounts for 160 acres yielding 3,840 bushels for on quota sale. Malting barley is seeded on 62 acres, and one carlot or 2,000 bushels is shipped on quota; feed barley is seeded on another 56 acres yielding 1,809 bushels for sale off quota. Flax claims 160 acres producing 2,224 bushels for commercial sale. In order to sell 11,079 bushels of grain on quota, 960 assignable acres are assigned to spring wheat, durum wheat, malting barley, and flax at the rate of 335, 427, 50, and 148 acres respectively. It is not possible for the farm to sell total output of 960 cultivated acres on quota; hence, 2,809 bushels of grain are sold off-quota as feed. Under Alternative 3, 285 acres are seeded to spring wheat, 160 acres to durum and 160 acres to flax, yielding 6,840, 3,840, and 2,224 bushels respectively. All grain is sold on the commercial market.

Table 9 portrays the capitalized value of fixed assets calculated from the net return above non-land costs under the assumption that the net income stream continues in perpetuity. Under Alternatives 1 and 2 the annual net return per cultivated acre is $7.91 and $6.38 respectively. Capitalized at the rate of 7 percent, the value per cultivated acre is $113 and $91 respectively. For 960 cultivated acres this results in a total land investment of $108,480 and $87,360 respectively.

Table 9

CAPITALIZED VALUE OF FIXED ASSETS
(at a 7 percent capitalization rate)

Asset	Units	Alternative 1	Alternative 2	Alternative 3
Total Annual Residual Income	$	7595	6122	6608
Total Cultivated Land	Acre	960	960	960
Annual Return Per Cultivated Acre	$	7.91	6.38	6.88
Capitalized Value Per Acre	$	113	91	98
Total Capitalized Land Value	$	108480	87360	94329
Added Annual Cost of Purchased Wheat Certificates	$			803
Less Annual Value of Barley Certificates Sold	$			140
Net Annual Cost of Certificates Purchased	$			663
Net Capitalized Value Purchased Wheat Certificates	$			9471
Total Capitalized Value of Fixed Assets	$	108480	87360	103800
Market Value of Existing Certificates	$			43700
Expected Total Value of Cultivated Land	$	108480	87360	50629
Expected Value Per Cultivated Acre	$	113	91	53

Under Alternative 3 the annual return per cultivated acre is $6.88, yielding a value per acre of $98 and a total land investment of $94,329. In Alternative 3 the purchase of 3,825 bushels of spring wheat certificates necessitates an annual outlay of 21 cents per bushel, or $803 in total. Although the cost of production and marketing this amount of spring wheat increases by 21 cents per bushel, the cost is in effect an annual return to a wheat certificate as a fixed asset. The capitalized value at 7 percent of certificates purchased is $2.48 per bushel, or $9,471 in total, resulting in a total investment in land and purchased spring wheat certificates of $103,800. Annual net return to land and purchased certificates as fixed assets totals $7,271.

Interpretation of Results

Under the open market alternative the farm specializes in those crops which maximize net return to land subject only to self-imposed constraints on production of particular crops. Although durum wheat is the most profitable alternative, it is voluntarily restricted to 160 acres and the balance of the land used to produce spring wheat. Any economies which may be realized by specialization in a few crops or intensification in the form of increased yield technology are possible because output is not constrained. Accordingly, increases in total farm productivity or efficiency are possible. It can be inferred that as this farm grows, other farms contract, go out of business, expand into noncommercial

grain production, or expand into livestock production. This farm is subject, however, to serious income fluctuations as the prices of its crops, which are assumed to be the same each year, fluctuate over time reflecting changing supply-demand situations.

The imposition of the assignable acreage alternative on the same farm causes a substantial change in production-marketing activities. Diversification into five crops and sale in two markets are induced. While it is possible to specialize in spring wheat and durum, total production must be cut back because it cannot all be marketed on quota. This results in increased costs, for fixed costs are spread over fewer bushels. Accordingly, to attain the same level of costs as in Alternative 1 the farm must operate at maximum output utilizing total available land. Though there are advantages to crop diversification in terms of reduced risk, there are increased costs, at least in the form of increased inconvenience because greater effort is required to handle and keep separate five grains rather than two. Furthermore, buyers must be found for the grain produced for off quota sale, or else livestock must be produced to utilize the grain.

Apart from the cost increasing effect of multiple competing activities, production efficiency and net income are reduced as the farm switches to lower income yielding crops. It can be inferred that the $1,473 reduction in net income is transferred via the quota mechanism to other farmers who

would not receive it under the open market alternative. In a similar fashion part of the value of land assets is transferred via the quota device to other farmers resulting in a tendency towards equalization of land values. In this connection analysis of the value of marginal products of resources reveals that a cultivated acre is worth more at the margin for its assignability to higher income producing spring wheat than it is in terms of production of feed barley for off quota sale. It follows that producers would be willing to purchase marginal land at a value greater than its productive worth to assign it to a higher income producing crop. Under Alternative 2 incentive for the application of yield increasing technology to commercial grains is lacking, for any increased production can only be marketed off quota at low prices. There is instead incentive to farm land extensively with large-scale equipment.

Alternative 3 provides a means whereby some of the lost efficiency incurred under Alternative 2 may be recouped. The farm reduces its production-marketing activities to three crops, all of which are marketed in the commercial market. Net return is increased by $486, and efficiency is increased slightly. The potential exists, however, for the farm to increase its productivity and use of yield increasing technology because marketing certificates may be purchased to market additional output. The opportunity for purchasing marketing certificates is a means whereby the farm may buy back the income stream transferred to other farmers under Alternative 2.

However, there is a problem with negotiable marketing certificates. Once certificates take on a value, then the certificates that the farm owns initially increase in value reflecting the trading price. There is a tendency for a windfall capital gain over time and increasing opportunity costs. This is likely to occur unless the value of land declines to offset the rise in value of marketing certificates. In the farm analyzed the value of all existing certificates owned is capitalized at $43,700 at the specified trading prices. Unless the market value of land investment falls to $50,629, or $53 per acre, the farm experiences either an increase in opportunity costs or a decline in the rate of return on investment. One way to encourage an offsetting fall in land values is to not include the cost of either land or certificates in the cost calculation. This implies that the value of both land and certificates will fluctuate over time reflecting changes in the net income stream. Under a rigid commodity price control system tied to the costs of production, the inclusion of the cost of fixed assets in the calculation may be expected over time to contribute to increasing prices.

When a grand quantitative optimum solution is impossible to calculate (as in the present study) it is possible to estimate a qualitative optimum, from among alternatives considered by; 1) precisely specifying the objectives to be sought, and 2) applying subjective probability tools. Subjective probability analysis, rooted in Bayesian statistical decision theory [Kotler, 1967, p. 212], is described by J. Hirshleifer [1970, p. 86] as a technique for facilitating the decision making process under uncertainty. The technique is an accepted means

of combining empirical information with intuitive or 'expert' judgement to yield an estimate of expected outcomes under various alternatives.

Analytical interpretations, arising from the results of a priori and empirical analysis of quota policy problems, objectives, and alternatives, are summarized in Table 10. Interpretations of the potential of each alternative for attaining each of eight primary objectives are reflected through a set of subjective probability estimates calculated by the author. (Under the assumption that each objective is equally preferred, equal weight is assigned to each; alternatively unequal weights could be assigned to reflect a preference ordering of objectives). In addition probability estimates are specified for each of eight secondary effects. While several alternative levels of probability could be chosen, the following three are employed here: low probability = 0.2; medium probability = 0.5; high probability = 0.8. (Levels 0.1, 0.4, 0.7 and 0.3, 0.6, 0.9 were also calculated and no change in results was noted).

The simple average (equal weights) probability estimate for achieving all primary objectives is calculated to be 0.57 for Alternative 1, 0.39 for Alternative 2, and 0.46 for Alternative 3. This means that Alternative 1, for example, is estimated to have a 57 percent probability of achieving all eight objectives. Similar interpretations are implied for all other estimates. The average probability estimates for influencing all eight secondary effects are 0.69, 0.54 and 0.65 for Alternatives 1, 2, and 3 respectively. Estimates of achieving all objectives and influencing all secondary effects are 0.63, 0.46, and 0.51 for Alternatives 1, 2, and 3, respectively.

Table 10

SUMMARY OF ANALYTICAL INTERPRETATIONS IN TERMS OF SUBJECTIVE PROBABILITY ESTIMATES OF ATTAINING QUOTA POLICY OBJECTIVES

Objectives and effects	Alternative 1	Alternative 2	Alternative 3
Primary Objectives:			
Orderly marketing	.5	.8	.8
More equal demand allocation	.2	.5	.2
Equitable income distribution	.8	.2	.5
Supply control	.2	.5	.5
Production efficiency	.8	.2	.5
Marketing efficiency	.8	.2	.5
Simplicity	.5	.5	.2
Flexibility	.8	.2	.5
Average probability (all objectives)	.57	.39	.46
Secondary Effects:			
Higher income	.8	.5	.8
More stable income	.2	.5	.5
Higher rate of technology adoption	.8	.5	.8
Specialization	.8	.5	.8
Diversification	.5	.8	.5
Higher land values	.8	.5	.2
More rapid market channel rationalization	.8	.5	.8
Higher rate of farmer out-migration	.8	.5	.8
Average probability (all effects)	.69	.54	.65
Average probability (all objectives and effects)	.63	.46	.51

Note: Levels of probability are: low probability = 0.2; medium probability = 0.5; high probability = 0.8. All primary objectives and secondary effects are assumed to carry equal weight.

If the subset of reasonable economic objectives--orderly marketing, production efficiency, and marketing efficiency--are isolated, the respective probability estimates of Alternatives 1, 2, and 3 achieving the subset are 0.70, 0.40, and 0.60. Similarly, if the apparent grain industry consensus on objectives--orderly marketing, supply control, and more equal demand, market channel, and income distribution--form a subset, then the average probability estimates are 0.30, 0.60, and 0.50 for Alternatives 1, 2, and 3 respectively. Similar average probability estimates may be calculated for every possible subset of objectives and effects.

If subjective probability estimates act as a basis for preference ordering, then for economic objectives, the open market would be preferred to negotiable marketing certificates, which would be preferred to assignable acreage quotas. For grain industry consensus objectives assignable acreage quotas would be preferred to negotiable marketing certificates, which would be preferred to the open market. The inversion of probability estimates and preferences in the latter instance results from the substitution of equal demand allocation and supply control objectives for production and marketing efficiency objectives.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

Summary

For thirty years the Canadian Wheat Board has operated a quota system for the purpose of equally distributing delivery opportunities and elevator space among producers. Evidence suggests a schism between actual impact and stated intent of quota policy on organization and performance in the grain industry and on income distribution among farmers. Although others have recently completed work on the quota question, there appears to be sufficient justification for analysis of quota policy problems, objectives, and alternatives utilizing specific economic and empirical tools.

Demand, competition, and supply response theory, along with six versions of modified perfect competition, are employed to assist in the examination of links between quota policy, the open market, orderly marketing, supply control, and supply management. Orderly marketing contributes to a minimization of seasonal price fluctuations, and supply control, to an increase in average seasonal prices; together they constitute supply management. Quota policy history reveals the gradual evolution of quota policy as a tool of supply management in the Western grain industry.

Regression analysis, economic theory, literature sources, and deductive reasoning are applied in an analysis of the relationships between quota policy and production, marketing, and income problems. It was found that delivery quota levels, coupled with price, delivery, and farm carry-over variables, were significant factors contributing to a Cobweb effect in aggregate wheat production levels. Although supply management has been implied in CWB operations over the past twenty years, this role appears not to have been well-handled, as evidenced by the lack of correlation between production and sales in any given year and by the problem of recurring grain surpluses.

Traditional quota policy has had important negative implications for farm organization and production efficiency. It has tended to induce land extensive farming practices to maximize the quota base (i.e., land) at the expense of higher yield technology for which marginal products are higher. Consequently, resources have not been combined in efficient (least-cost) ratios because of overutilization of land (relative to other inputs) in production processes. Quota policy appears to have been partly responsible for a lag in Western grain farming productivity behind grain farming productivity in the United States. However, productivity has increased at a faster rate than in many other sectors of the Canadian economy.

The restrictive and equalization aspects of quota policy have tended to discourage specialization in commercial grain production. Instead, the quota system has encouraged product and market diversification within farms and across

the prairie region, regardless of comparative advantage, soil-climatic capability and producer preference. The cost of an interregional shift in production, in violation of spatial competitive equilibrium, has contributed to increased aggregate costs and reduced production efficiency. In addition, quota equalization across the region has tended to equalize land values; low productivity land has ta taken on values in excess of those warranted by physical productivity (higher prices are paid for the attached quota rights).

Quota policy plays an important role in determining grain market structure. A 'spin-off' effect of orderly marketing and price stability in the commercial market appears to be greater disorder in non-quota feed grain and livestock markets. This is because under quotas these markets act as buffers between variations in grain production and commercial sales. Pareto optimum within the agricultural industry is violated; sellers of off-quota grain and livestock producers are generally worse off.

Quota allocation of derived demand, delivery opportunities, market channels, and income appears to be different from that expected under the open market version of perfect competition. In general, quota level equalization induces a quantitative transfer from low cost, efficient, larger farms to high cost, less efficient, smaller farms. Even under the most favourable reallocation of demand, about 100 thousand prairie grain farms with less than 400 specified acres appear not to possess sufficient resources to earn a reasonable income from commercial grain production. Thus quota policy would not seem

to be very effective as an instrument of social policy.

It is apparent that past quota policy has contributed to reduced marketing efficiency in both exchange and operational dimensions. Exchange efficiency is reduced because quotas, rather than price, allocate demand, thereby masking efficiency-inducing effects of price variations. Operational efficiency has been reduced because quotas, along with the boxcar order system, storage, handling, and transportation rates, contribute to the maintenance of surplus capacity in market channels--country elevators and rail lines. Elevator handling/capacity ratios measure about half that necessary for a high level of efficiency; quota policy compounds a situation where no elevator may sustain increased throughput.

Analysis of potential objectives for a demand allocation program for grain reveals important conflicts among orderly marketing, production and marketing efficiency, equality, and equity (in the sense of Pareto optimum allocation). Reasonable economic objectives appear to be orderly marketing and production and marketing efficiency. Assessment of grain industry consensus suggests that orderly marketing, equal demand allocation, and supply control are favoured goals.

Three alternative demand allocation programs are specified: 1) the open market--the absence of institutional influences; 2) assignable acreage quotas--institutional allocation of demand in proportion to land; and 3) negotiable marketing certificates--institutional allocation of demand in proportion

to output quotas, transferable apart from other resources.

The analytical procedure in the present study consists of: 1) a priori analysis of general impacts, and 2) linear programming analysis of specific impacts on a typical prairie grain farm for the purpose of assessing the potential of each alternative for achieving various objectives. A reflection of the analytical results in a set of subjective probability estimates suggests that for eight primary objectives, the open market, followed by negotiable marketing certificates and assignable acreage quotas in declining order, has the highest probability of achievement. The same order holds for the preferred subset of economic objectives. However, when the subset of objectives having apparent grain industry consensus is isolated, assignable acreage quotas, followed by negotiable marketing certificates and the open market respectively, have the highest probability of attainment. The inversion of probability estimates in the latter instance results from the substitution of equal demand allocation and supply control objectives for production and marketing efficiency objectives.

Conclusions

A decision regarding the most appropriate means of demand allocation in the Western grain industry ought to consider, in addition to the factors discussed in the present study: 1) the needs and desires of participants in the grain industry; 2) the long run implications for competitiveness in export

markets; 3) the impacts on regional economic growth; and 4) the contribution to national economic goals.

Though consideration was given to the apparent consensus of grain industry objectives, it is implicit that there are many farmers (the exact number is unspecified) who would not subscribe to these goals. Likewise, not all farmers are profit maximizers; personal goals and ambitions vary greatly. Farm cost structures are also variable; interpretations based on the analysis of impacts on one such structure are limited.

The long run implications of an efficiency constraining policy are unknown; however, it may be expected that for an industry depending heavily on exports, failure to focus policies on efficiency maximization is likely to lead ultimately to uncompetitiveness, lost markets, and decline. For the grain industry, remaining competitive in spite of lower efficiency is likely to imply over time, declining returns to land and falling land values.

A policy which discourages efficiency in the grain sector reduces its net contribution and maintains regional growth below potential. Similarly, the grain industry's contribution to national economic goals and aggregate welfare is diminished. The magnitudes of these effects remain unquantified.

Analytical results in the present study necessitate the conclusion that of the quota alternatives considered, the open market is the optimal demand allocator for Western grain. Although the open market has imperfections,

these appear to be outweighed by the advantages it offers; it has the highest probability of achieving the greatest number of objectives. The policy focus ought to be on how best to improve the operation of the open market, not on how to weaken it. While certain legislative and institutional problems would have to be overcome, its implementation would not imply elimination of the Canadian Wheat Board; instead it would imply the incorporation of measures within CWB-industry structure, for effecting a closer approximation of the competitive equilibrium obtainable from the open market.

A negotiable marketing certificates system is suboptimal, although in terms of the probability for achieving reasonable economic objectives, it is preferable to assignable acreage quotas. It would be a useful system for achieving efficiency within a supply control context and, therefore, would be especially applicable to commodities sold in domestic markets insulated from other supply sources where demand elasticity is low and price maximization is an objective. Accordingly, it would not be particularly appropriate for export commodities with high demand elasticities or for situations in which sales maximization is or ought to be an objective.

Finally, the assignable acreage quota system is also suboptimal, but correct for the objectives at which it is aimed. However, these objectives appear to be inappropriate for the long run competitive interests of the Western grain industry, the prairie region, and the national economy. If quotas could be declared open for every grain, every year (implying a dramatic increase in sales), then many of the potentially harmful impacts of the system would be overcome.

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APPENDICES

APPENDIX A

MULTIPLE REGRESSION DATA

APPENDIX A

MULTIPLE REGRESSION DATA

TABLE 1

VARIABLES EXPLAINING VARIATIONS IN SEEDED ACREAGE OF WHEAT

Crop Year	$\hat{Y}$	Y	X_1	X_2	X_3	X_4	X_5
	acres	acres	dollars	bushels per acre	bushels	bushels per acre	bushels
1954-55	22.9	24.7	1.56	8.1	232	7.0	397
55-56	22.3	22.0	1.65	7.0	138	9.0	320
56-57	23.4	22.1	1.61	9.0	204	7.5	353
57-58	21.4	20.9	1.59	7.5	323	6.5	362
58-59	22.0	21.5	1.62	6.5	241	7.5	378
59-60	23.0	24.0	1.60	7.5	169	7.9	368
60-61	24.1	23.9	1.59	7.9	144	7.4	379
61-62	25.5	24.6	1.80	7.4	171	7.9	396
62-63	25.6	26.2	1.91	7.9	59	10.4	305
63-64	26.5	27.0	1.87	10.4	65	12.4	474
64-65	28.9	29.1	1.97	12.4	121	12.2	567
65-66	29.6	27.8	1.89	12.2	109	10.0	525
66-67	30.1	29.2	2.00	10.0	100	10.4	569
67-68	28.8	29.6	1.99	10.4	205	10.8	632
68-69	27.7	28.9	1.81	10.8	236	7.0	456
69-70	23.3	24.4	1.70*	7.0	372	5.4	423
70-71	19.0	18.0*	1.55*	5.4	500*	4.9	413

*estimated

TABLE 1

VARIABLES EXPLAINING VARIATIONS IN SEEDED ACREAGE OF WHEAT
(continued)

Explanation:

$\hat{Y}$:	Estimated value of seeded wheat acreage in crop year t
Y:	Actual seeded wheat acreage in crop year t
X_1:	Final realized price for No. 1 Northern wheat in store, Thunder Bay, in crop year t-1
X_2:	Eligible delivery quota rate per specified acre in crop year t-2
X_3:	Ending farm carry-over of wheat in crop year t-1
X_4:	Eligible delivery quota rate per specified acre in crop year t-1
X_5:	Actual wheat deliveries in crop year t-1

Source: Canadian Wheat Board, Annual Reports. (Winnipeg: CWB, Crop Years 1952-53 to 1968-69.

APPENDIX B

LINEAR PROGRAMMING DATA

APPENDIX B

LINEAR PROGRAMMING DATA

TABLE 1

IDENTIFICATION OF VARIABLES

Variable Name	Variable Description
Objective Function:	
Z	Maximize Returns to Land
Activities:	
Commercial (on-quota) Sale:	
X_1	Sell 1 bushel spring wheat
X_2	Sell 1 bushel durum wheat
X_3	Sell 1 carlot (2000 bushels) malting barley
X_4	Sell 1 bushel feed barley
X_5	Sell 1 bushel oats
X_6	Sell 1 bushel rye
X_7	Sell 1 bushel flax
X_8	Sell 1 bushel rapeseed
X_9	Sell 1 bushel spring wheat--buy marketing certificate
X_{10}	Sell 1 bushel durum wheat--buy marketing certificate
X_{11}	Sell 1 carlot (2000 bushels) malting barley--buy marketing certificate
X_{12}	Sell 1 bushel flax--buy marketing certificate

TABLE 1

IDENTIFICATION OF VARIABLES
(continued)

Variable Name	Unit of Measure	Variable Description
Activities: (ctd)		
Noncommercial	(off-quota) Sale:	
X_{13}		Sell 1 bushel feed wheat
X_{14}		Sell 1 bushel feed barley
X_{15}		Sell 1 bushel feed oats
X_{16}		Sell 1 bushel feed rye
Constraints:		
b_1	acres	Cultivated land
b_2	acres	Assignable land
b_3	acres	Durum wheat seeded
b_4	acres	Flax seeded
b_5	acres	Rapeseed seeded
b_6	bushels	Malting barley quota--existing certificates
b_7	bushels	Noncommercial feed wheat limit
b_8	bushels	Noncommercial feed barley limit
b_9	bushels	Spring wheat--existing certificates

TABLE 1

IDENTIFICATION OF VARIABLES
(continued)

Variable Name	Unit of Measure	Variable Description
Constraints: (ctd)		
b_{10}	bushels	Durum wheat--existing certificates
b_{11}	bushels	Flax--existing certificates
b_{12}	bushels	Spring wheat--purchased certificates
b_{13}	bushels	Durum wheat--purchased certificates
b_{14}	bushels	Malting barley--purchased certificates
b_{15}	bushels	Flax--purchased certificates
b_{16}	bushels	Total grain sales
b_{17}	dollars	Total revenue
b_{18}	dollars	Total cost

TABLE 2

LINEAR PROGRAMMING MATRIX: OPEN MARKET ALTERNATIVE

Z	.47	.67	360.	.07	.02	-.47	.73	-.17	.11	.03	-.16	-.65		
X / b	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_{13}	X_{14}	X_{15}	X_{16}	6 Slack Variables	b Level
b_1	.066	.066	98.	.049	.04	.095	.114	.132	.066	.049	.04	.095	1	960
b_3		.042											1	160
b_4							.072						1...	160
b_{16}	1.	1.	2000.	1.	1.	1.	1.	1.	1.	1.	1.	1.	...-1	0
b_{17}	1.53	1.73	1940.	.86	.66	1.06	2.55	1.94	1.16	.82	.48	.88	-1	0
b_{18}	1.06	1.06	1580.	.79	.64	1.53	1.82	2.11	1.06	.79	.64	1.53	-1	0

TABLE 3

LINEAR PROGRAMMING MATRIX: ASSIGNABLE ACREAGE ALTERNATIVE

Z	.47	.67	360.	.07	.02	-.47	.73	-.17	.11	.03	-.16	-.65		
X / b	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_{13}	X_{14}	X_{15}	X_{16}	11 Slack Variables	b Level
b_1	.066	.066	98.	.049	.04	.095	.114	.132	.066	.049	.04	.095	1	960
b_2	.111	.111	50.	.05	.067	.05	.067	.05					1	960
b_3		.042											1...	160
b_4							.072							160
b_5								.083						160
b_6			2000.											2000
b_7									1.					1000
b_8										1.				4500
b_{16}	1.	1.	2000.	1.	1.	1.	1.	1.	1.	1.	1.	1.	...-1	0
b_{17}	1.53	1.73	1940.	.86	.66	1.06	2.55	1.94	1.16	.82	.48	.88	-1	0
b_{18}	1.06	1.06	1580.	.79	.64	1.53	1.82	2.11	1.06	.79	.64	1.53	-1	0

TABLE 4

LINEAR PROGRAMMING MATRIX: NEGOTIABLE MARKETING CERTIFICATES ALTERNATIVE

Z	.47	.67	360.	.73	.26	.36	220.	.40	.11	.03		
b \ X	X_1	X_2	X_3	X_7	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	14 Slack Variables	b level
b_1	.066	.066	98.	.114	.066	.066	98.	.114	.066	.049	1	960
b_3		.042				.042					1	160
b_4				.072				.072			1. . .	160
b_6			2000.									2000
b_9	1.											3015
b_{10}		1.										3840
b_{11}				1.								2224
b_{12}					1.							0
b_{13}						1.						0
b_{14}							1.					0
b_{15}								1.				0
b_{16}	1.	1.	2000.	1.	1.	1.	2000.	1.	1.	1.	. . .-1	0
b_{17}	1.53	1.73	1940.	2.55	1.53	1.73	1940.	2.55	1.16	.82	-1	0
b_{18}	1.06	1.06	1580.	1.82	1.27	1.37	1720.	2.15	1.06	.79	-1	0